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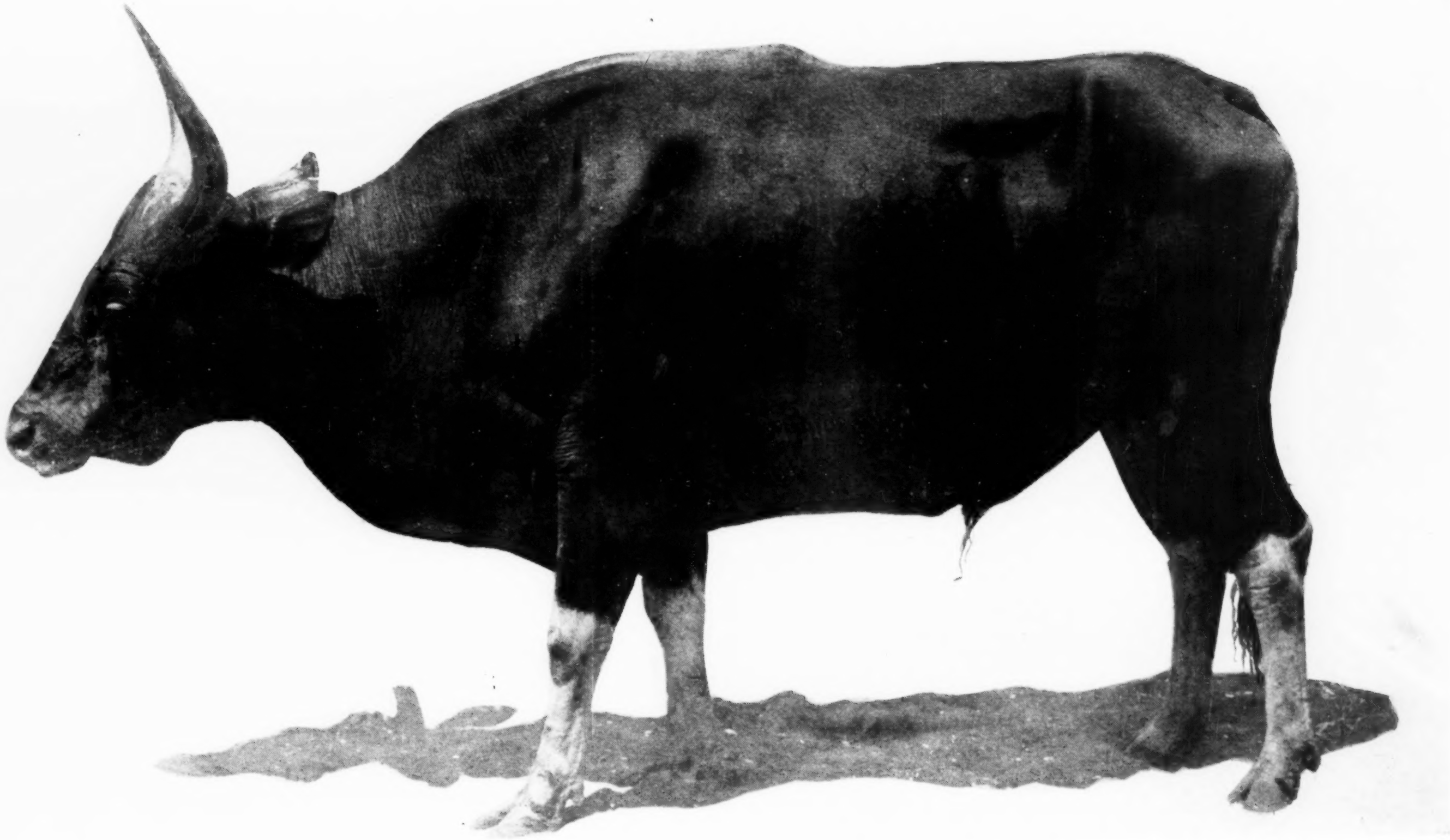

PROBABLE ANCESTRAL TYPE OF ZEBU CATTLE

Timor bull at Pandacan Quarantine Station, Philippine Islands. He is probably nearly full-blood Banting. The Banting (*Bos sundaicus*) is a wild bovine of the East Indies which, according to C. Kellar, is the ancestral type of the modern zebu cattle; although most students think that hybridization has introduced other elements into the zebu make-up. Noteworthy features of this bull are the peculiar neck, dewlap running back to the navel, and hump somewhat similar to that of the carabao or water-buffalo. Photograph from the Bureau of Agriculture, Manila. (Frontispiece.)

ZEBU CATTLE IN BRAZIL

Imported Stock Crossed on Native—Hybrids are Popular with Ranchers—Hardy, Disease-Resistant and Fairly good Milkers—High Prices Paid—Possibilities of Interest to United States.

B. H. HUNNICUTT

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ZEBU cattle are attracting attention from animal breeders in all the warmer parts of the world at the present time, and are assuming particular importance among ranchers in the southern United States, because of their relative immunity to the disastrous Texas fever.[1] Many genetists believe that by crossing the zebu on native stock, a new breed can be produced that will be of great value; and as Brazil has been making such an experiment on a very large scale for many years, I think it will be of interest to breeders to know what the results have been as they appear to me and to other students.

The zebu (*Bos indicus*), as is well known, is a native of the Indo-Malayan region, and was certainly domesticated several thousand years before the beginning of the Christian era. According to C. Kellar, it represents nothing more than a domesticated Banting (*Bos sundaicus*), although most students look on it as the result of hybridization. The name "zebu" is said to have been given it by the French naturalist Buffon, who described it in his Histoire Naturelle (published from 1749 to 1767) from specimens which he had seen in a menagerie, and which had been given by the showman the apparently fictitious name of *zebu*, a name not known in India.

As far as I have been able to learn, the first importations of zebus to Brazil were made about forty years ago[2], one of the earliest being by Sr. Acacio Americo Corréa de Azevedo, who secured a bull and cow from London Zoological Gardens. It is probable that all the early importations[3] were made from London by the English firm, Crashley & Co.; only in later years have the importations on a large scale been made direct from India.

CATTLE BRING HIGH PRICES

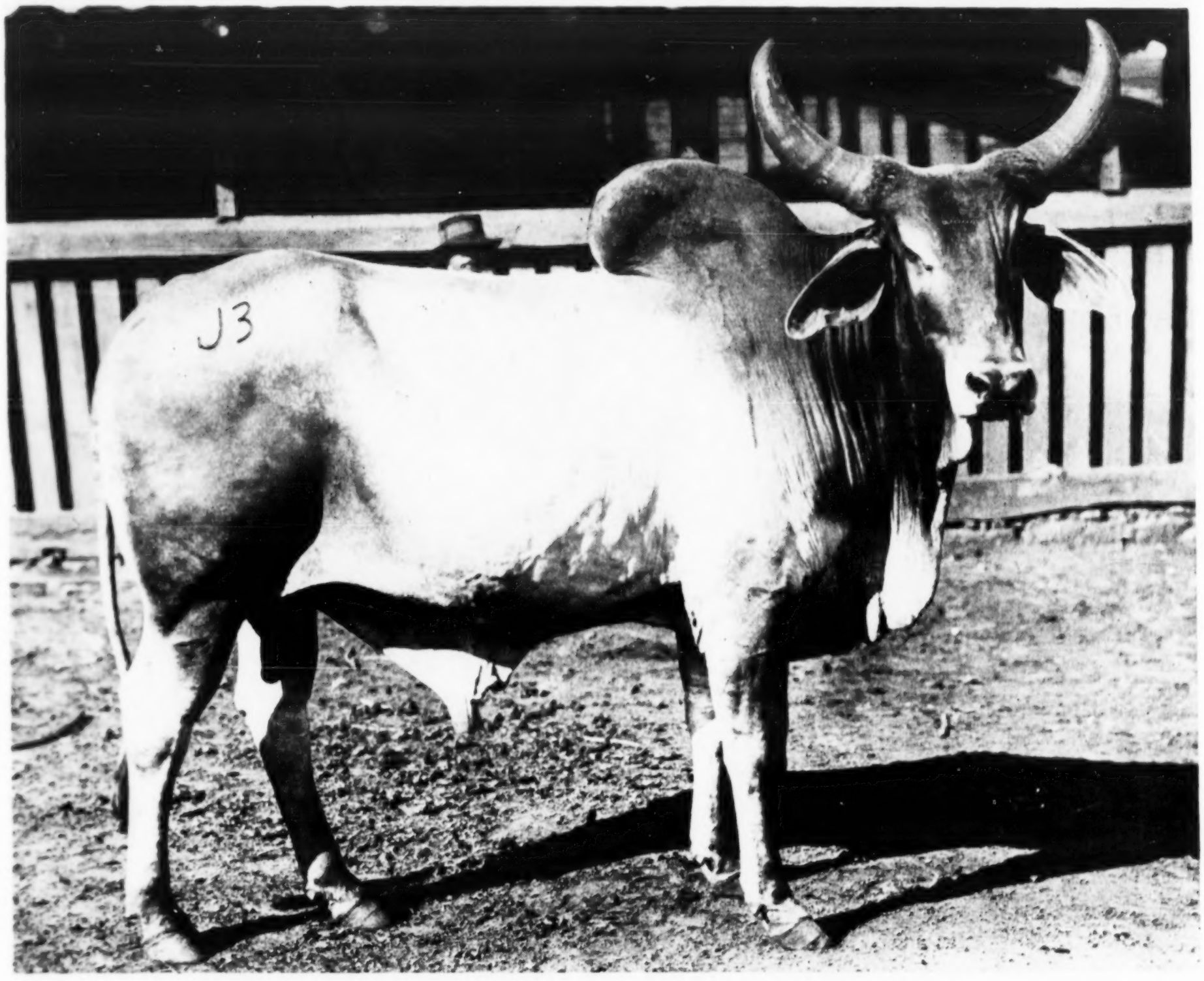
The breed gained rapidly in popularity. Some twenty years ago an offer was made[4] in Uberaba, Minas, of 42 contos de reis for a zebu bull. This is about $14,000 in American gold; and, by the way, the offer was refused. The owner of this bull amassed quite a fortune and the herd is still considered the best in Brazil. It is now in the hands of the son who has become a millionaire as a result of his reputation

[1] For an account of what has been done in this direction, see Borden, A. P., "Indian Cattle in the United States," *American Breeders' Magazine*, I, 91, Washington, 1910 (also in annl. report A. B. A., VI, 1910); "Zebu Cattle Resistant to Texas Fever," *ibid.* III, 233, 1912 (see also twenty-sixth annl. report of the Bureau of Animal Industry, Washington); Nabours, Robert K., "Possibilities for a New Breed of Cattle in the South," *ibid.*, IV, 38, 1913. For a discussion of the genetic problems involved in zebu crosses see Nabours, R. K., "Evidence of Alternative Inheritance, etc.," in *Amer. Naturalist*, July, 1912, and Cook, O. F., "Mendelism and Interspecific Hybrids," *ibid.*, April, 1913.

[2] Inquerito sobre o Zebú, Sociedade Nacional de Agricultura, Rio de Janiero, 1907.

[3] It is probable that, as Nabours refers in his article on Zebu cattle (Possibilities of a New Breed of Cattle, R. K. Nabours, *American Breeder's Magazine*, Vol. IV, No. 1) to the introduction into the United States of Indian cattle characteristics, especially in the Southwest, through Mexico from Spain, the influence of the breed was introduced into Brazil soon after the discovery. Or as Anderson says ("A Fazenda" Anno 111, N. 29, Out. de 1912) in his letter to Dr. Travassos, there may have been importations into northern Brazil several centuries ago.

[4] "A Criação do Gado no Brazil," M. Bernardez, Imprensa Nacional, Rio de Janeiro, 1909.



SUPERB TYPE OF THE GUJARAT BREED

"Ceylão," herd bull on the estate of Sr. José Caetano Borges at Uberaba, Minas Geraes, Brazil, was imported from India, and is considered to be almost a perfect specimen of this variety, while the herd which he heads is reputedly the finest in Brazil, where zebu cattle have become immensely popular in some districts during the last generation. (Fig. 1.)

for these cattle. Most of the photographs for this paper are from the herd of this breeder.

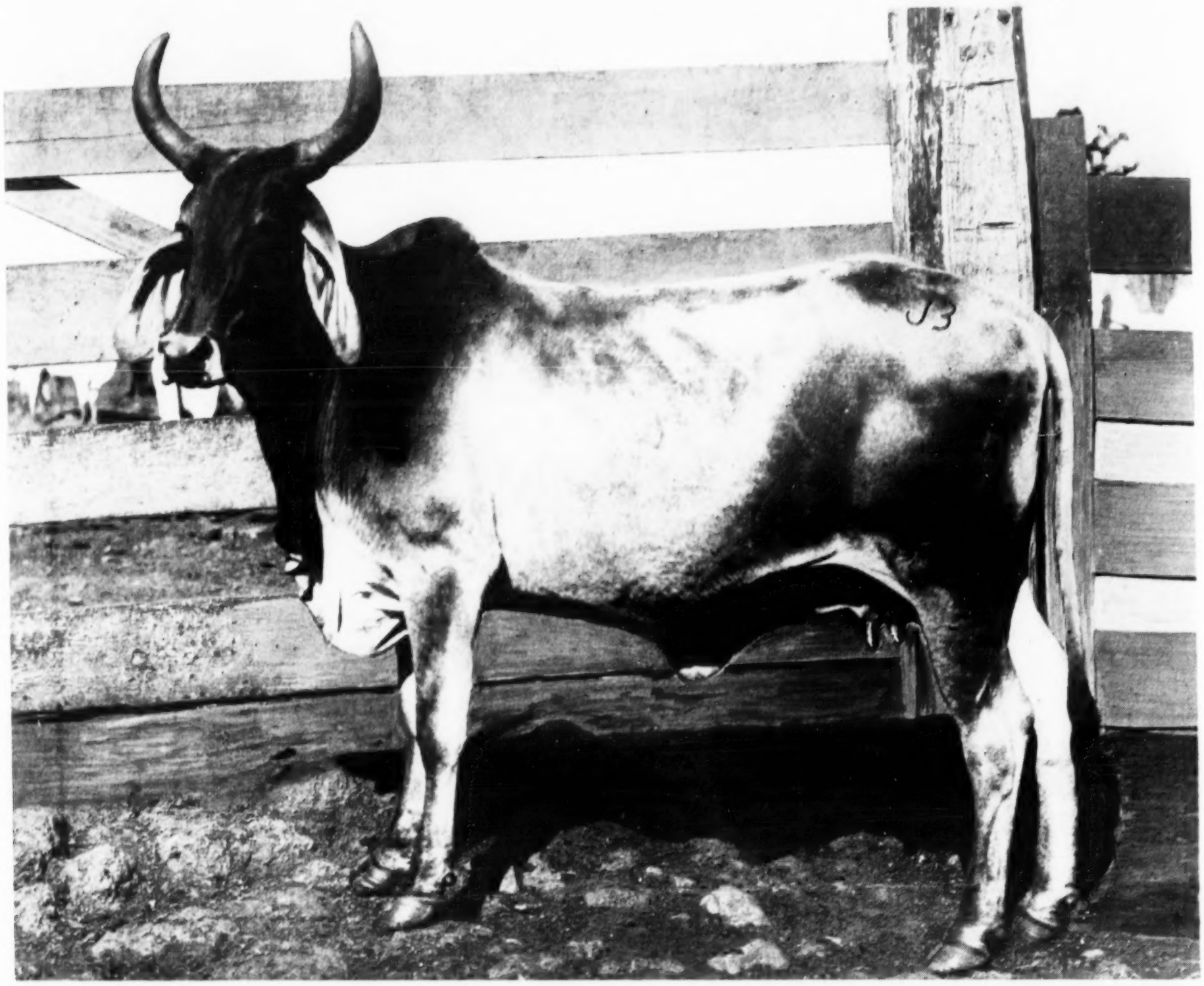
It has not been possible for me to determine exactly the number of Indian cattle that have been imported into Brazil. The greatest activity in importations direct from India seems to have been during the period 1907-1910 when one firm alone in Rio de Janeiro imported over 1,200 head. In 1910 the number imported[5] was 620, in 1911 only ninety-three, and since then even less.

What is known as the "Triangula Mineira," a triangular section of the state of Minas Geraes to the extreme western part of the State, extending from the city of Uberaba to Araxa, is the stronghold of the zebu in Brazil,[6] the place where the greatest number of pure bred zebus are to be found, and where stockmen are enthusiasts for the breed and long prices are paid for exceptional animals.

It is probable that throughout the whole of the vast state of Minas Geraes hybrids of the zebu will be found, so largely have they been scattered during the last few years. No doubt Minas is the State where they are most bred, but they are also raised in the adjoining States, Rio de Janeiro, Espirito Santo, Goyaz, Bahia and to some extent in the

[5] Foreign Commerce of Brazil, Ministro da Fazenda, Rio de Janeiro, 1912.

[6] For a good description of this region see Industria Pecuaria, pages 39-59, Imprensa Official, Bello Horizonte, 1912.



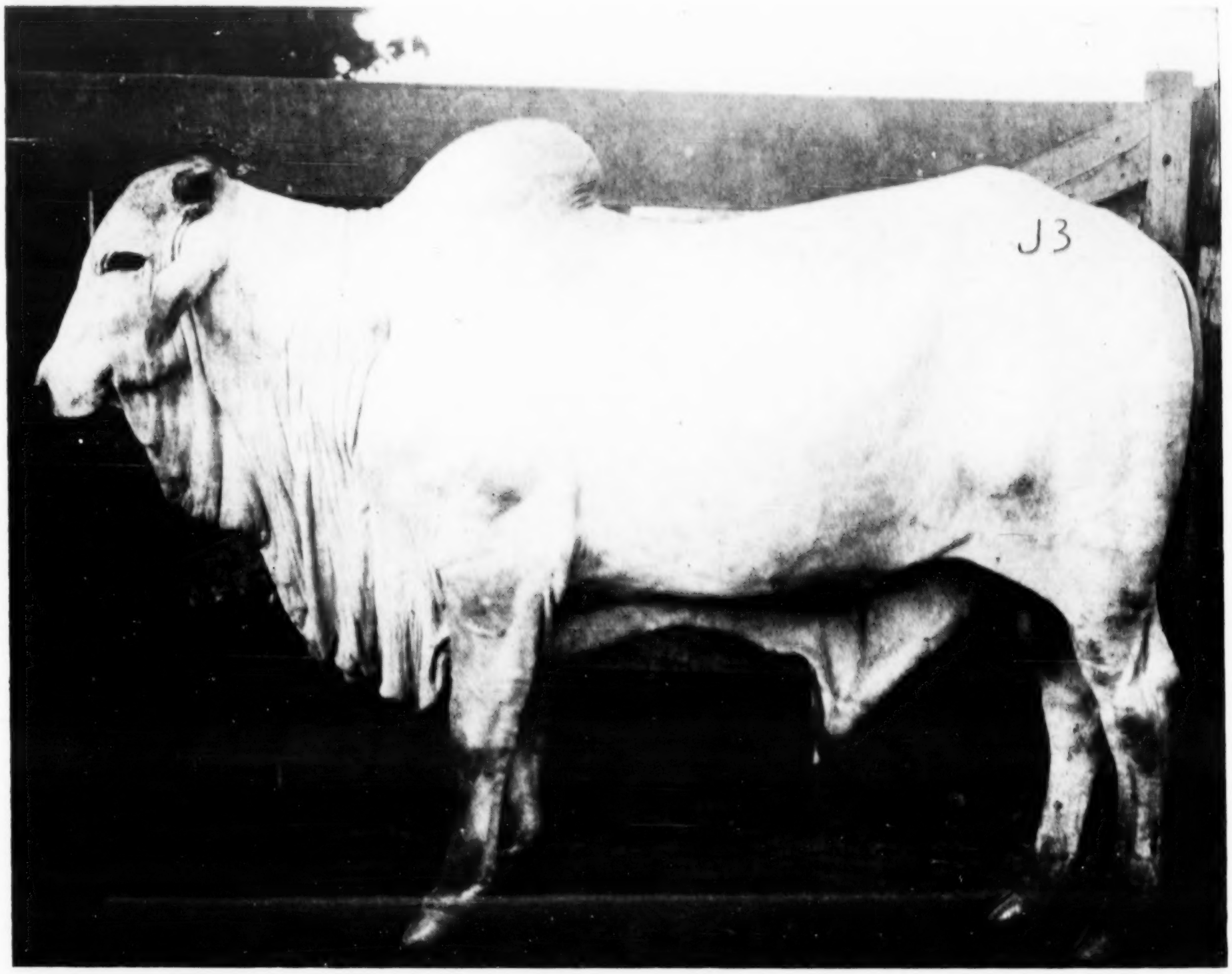
"THE BEST ZEBU COW IN BRAZIL"

"Polonha," a pure-blood Gujarat, is the property of Sr. José Caetano Borges of Uberaba, Minas, and is considered by him to be the best cow of this breed yet imported from India. Her owner has become a millionaire, as a result of the reputation of his herd. (Fig. 2.)

states of the northern part of Brazil. Up until 1907 they were unknown in some of the northern States but it is probable that they have spread since then to all the northern States. They have never been in much favor in São Paulo or in any of the southern States, so far as I have been able to learn. The bovine population of Brazil is given at 30,000,000 and a large percentage now has at least a trace of zebu blood.

Many breeds or varieties of zebu are distinguished, both here and in India, but it will not be necessary to discuss them for the purpose of this article. The only ones of great commercial importance in Minas are the Gujarat and Nellore, although the Gir and Hissar are fairly common. The Gir is considered the best for milking purposes, but milk is not a primary consideration in the Brazilian cattle industry. No particular care seems to be taken to keep the various breeds separate, on Brazilian ranches, and they are freely interbred.

In January, 1914, I made a short trip with Messrs. P. H. Dorsett and Wilson Popenoe, agricultural explorers of the U. S. Department of Agriculture, to study the cattle industry of this part of Brazil on the farms of two important breeders, Snrs. Pedro and Cassiano Lemos of Pratinha, State of Minas Geraes. Their ranch, in an open, rolling, well watered and well grassed country, originally contained more than 160,000 acres of land, and most of it



A NELLORE-GUJARAT CROSS

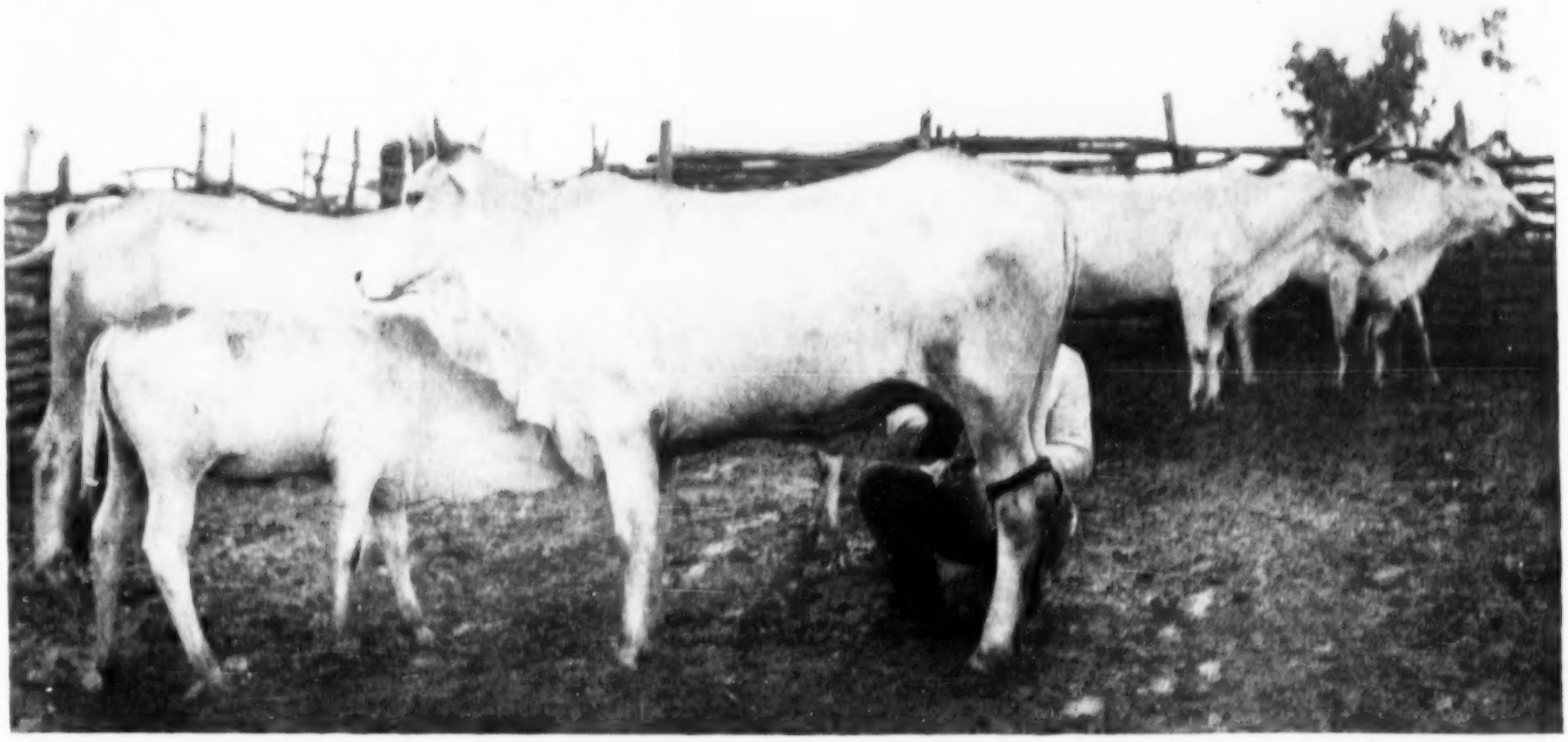
The two principal breeds of zebu cattle in Brazil are the large, long-eared, long-horned Gujarat, and the smaller, more graceful, shorter-horned Nellore. This two-year-old bull, "Marmore," bred by Sr. José Caetano Borges of Uberaba, Minas, Brazil, is a cross between the two breeds mentioned. Brazilian breeders on the whole do not take any particular care to keep the various breeds of zebu separate, but mix them and cross them indiscriminately. (Fig. 3.)

is still in the hands of the family. Sr. Cassiano Lemos has about 900 head of purebreds and crosses, the latter being mostly half or seven-eights zebu, on the native or "crioulo" stock. These crosses in most cases have all the colors and characteristics of the Indian cattle.

ZEBUS ARE FECUND

The Lemos brothers speak highly of the zebu as a general purpose animal. The bulls are very fecund, and the cows, hybrid or purebred, are much more prolific than the native Brazilian cattle. The animals remain nearer together in the herd than do most cattle—an advantage when it is desired to corral them from the range. I saw one little boy sent out to bring in a large herd single handed.

The cows are milked only once a day—early in the morning. A good milker yields from 1 to 3 gallons: we saw a herd of 200 cows, pasture-fed only, which yielded 600 litres (634 quarts). After milking, the cows are turned out and their calves allowed to run with them and suck until about 2 o'clock in the afternoon, when they are separated until next morning; the calf is weaned at the age of 6 months. Mr. Lemos told us that they lose about 10% of their young calves from various causes—diarrhea or lack of care. The calf is a valuable assistant to the rancher at milking time, being turned into the corral with his mother and allowed to



MILKING IN BRAZIL

On the big ranches of Brazil the cows are only milked once daily—in the morning. They yield milk in most cases only while they have a calf at their sides. At milking time the calf is first turned into the corral with its mother and allowed to nurse; after it has sufficient nourishment, it is tied to the cow's right foreleg, the cow's hind legs are tied together, and the milker then "pails" her. In the photograph the calf is seen tied to his mother, with his head hidden by her dewlap. The milking qualities of zebus are somewhat disputed, but under favorable conditions it appears that they yield one or two gallons a day, and that the milk is of excellent quality. (Fig. 4.)

nurse. When the milker thinks it is time to check activities in that connection he ties the calf to the right foreleg of his mother, puts a rope around each of the hind legs of the cow, just above the hock, and ties them lightly together; then places the bucket between his knees and finishes the milk flow which the calf started.

We found that ticks will catch to some extent on a zebu, but do not seem to bother them at all. I have never known of a case where a native-born or imported zebu had tick fever. They are troubled to some extent with blackleg, against which vaccination is practiced; and also by the ox warble (*Hypoderma lineata?*)

It has been alleged that the zebu hybrids are very wild, even savage, as far as the third or fourth generation, no matter how docile the stock on which they are crossed. There is some truth in this, at least. They cannot be called tame cattle; but on the farms of the two gentlemen mentioned above I had occasion to note that where these cattle are carefully treated they give little or no trouble. I saw no cows milked that it was necessary to tie up in a trunk, as is claimed by some to be necessary. The purebred calves are caught every day and brushed so as to accustom them to handling.

Let me now give some opinions *pro* and *con* about the zebu from men who know him.

PRAISE OF THE ZEBU

Sr. Theopompo de Almeida[7] says, "I have imported breeding stock of various European breeds, among them Durham, Simmenthal, Brown Swiss, Polled Angus and Hereford; and in spite of the greatest efforts in well-cared-for artificial pastures to give the merited attention, the result has always been negative; however the zebu progresses admirably,

[7] Minas Geraes, July 15, 1914, p. 2.

fullfilling all my necessities. I have cows as good milkers as "Turinas" and Holsteins, with the advantage that their milk is of a much better taste.[8] As to the meat, it is the best possible." He speaks of how well the cattle stand being driven long distances to market,—he even uses them as pack animals.

Dr. Carlos Prates says,[9] "The zebu is, as proved, a breed resistant, easily acclimatized, and one that lives perfectly on our prairies, suffering little from the tick or other parasites. Further, it is proved that the first cross of the zebu bull with native cows give better products as to size, resistance and beauty; from this principally comes the preference of the zebu."

Dr. Alvaro da Silveira[10] remarks, " 'The zebu should be exterminated for the good of the nation's livestock industry' affirm those who say they are sustained by the solid basis of science. 'We shall continue to make use of the zebu because he makes us rich' say the breeders, sustained by the de facto profits that they receive from the undesired breed.

"It seems that, however patriotic the scientist may be, his love for the fortune of the zebu breeder is, in any case, less intense than that of the breeder himself for his property. And since the farmer is satisfied with this process of breeding, I am inclined to think it is *science* that is in error, because no one will believe that hundreds of Minas breeders will breed the zebu just to defend a bad breed, contrary to their actual interests."

Dr. N. S. Mayo as above cited says, "Among the good qualities of the Indian cattle are their hardiness, exemption from parasites, such as flies and ticks. Because of their size, strength and activity, Indian cattle are the best for the tropics."

Dr. L. P. Barreto[11] writes, "On all sides (in the state of São Paulo) the zebu is repelled with indignation. And this repulsion, happily, is the official doctrine; in our cattle shows (state of São Paulo) the zebu is excluded."

Sr. Manoel Bernardez compares the meat to that of the rhinoceros and says that to replace the native Brazilian cattle with the zebu would be to return to the stone age.

Dr. Eduardo Cotrim[12] goes into detail to prove that the zebu is undesirable from all standpoints, as a work animal (most traction work in the tropics is done with oxen) as a milk animal and as a beef animal. He even quotes the opinion of another, to which he evidently acquiesces, that it will some day be necessary to exclude the Indian cattle from Brazil by legislation.

These opinions have been given because there are two schools as it were, or rather two factions among the breeders in Brazil, one fanatically for the zebu, which is made up of the practical breeders who profit handsomely by breeding them, and those who go just as far to the other extreme, composed mostly of theorists and partisans of the European cattle (without much knowledge of the conditions under which the zebu cattle are proving so profitable).

The ideas thus suggested may have some weight with those interested in the United States or who intend crossing the Brahmin or zebu cattle for range purposes.

THE AUTHOR'S OPINION

To close I shall give two interesting opinions with which I agree.

Dr. Elias Antonio de Moraes[13] reminds us that "Indian cattle are to the bovines of other species what the mule is to the horse and the goat to the sheep," as to both vigor and health. He is also of the opinion that Brazil should be divided into three zones—the first near the large centers of consumption, for such breeds as Holsteins, Brown Swiss, etc. In the second zone cattle especially apt for the production of butter

[8] The author's observation is that zebu milk has a very rich and superior flavor.
[9] Industria Pecuaria, *loc. cit.*, p. 18.
[10] Industria Pecuaria, *loc, cit.*, p. 55.
[11] Industria Pecuaria, *loc. cit.*, p. 6.
[12] Inquerito Sobre o Zebú, *loc. cit.*, pp. 71-92.
[13] Inquerito Sobre o Zebú, *loc. cit.*, pp. 95-97.

and cheese, easily transported to market, should be bred. In the third zone in the interior the zebu would be the proper breed. This third zone corresponds to the ranges of the western United States; there and there only would I expect to see the zebu profitable.

There is this to be said, however, when the above evidence is being weighed, that hybridization with the zebu has hitherto been carried on in a wholly hit-or-miss manner, in most cases. Certainly this is the case in Brazil, and I understand that the breeding in Texas has not been accompanied by careful records. If the resources of the modern science of genetics were applied to the problem, it is possible that much better results would be secured. The importance of the problem for the tick-infested area of the southern United States, and for all warm parts of the world, is such that I strongly urge the United States Department of Agriculture to send competent zootechnists to Brazil to investigate the matter thoroughly. Brazilian breeders declare that the zebu is improving under the better care and feeding it gets in Brazil. Science ought to know exactly what has been accomplished here, and I am sure that the Brazilian government would be glad to cooperate with that of the United States, in an endeavor to place the facts on record.

ZEBU CROSSES IN TUNISIA[1]

M. Roederer, *Mateur, Tunisia*

ATTEMPTS to use zebu blood in improving tropical races of cattle are not novelties. The zebus and their crosses are, it is abundantly proved, resistant to the Texas fever and to anthrax; furthermore, they are very little disturbed by foot and mouth disease. This does not mean that the blood of these animals is exempt from the protozoa of Texas fever. Recent experiences have shown the contrary; but they are in smaller number and do not seem to act injuriously on the organism. Was it not a temptation, then, for us Tunisians, to try to cross our native cattle with stock from warmer and less favorable climates than the one under which we live?

One might say of the zebu that it is the "American stock"[2] of cattle breeding. Aside from the great advantages which it presents in resisting disease, the use of the zebu in crosses gives other precious results. The hybrids resist the heat perfectly—in fact, they thrive best in summer. After the hottest days, they return from the severe labor of plowing, with the eye fresh and the flank scarcely heaving. They fear cold weather more than anything else. Their great facility for assimilating dry fodder is an immense advantage in this country; they are less particular about the quality of their food than even the Arab cattle. Zebu breeding is, then, easy and presents few problems.

Now let us see what their crosses are like, as regards structure, weight, meat-production, milk-yield, fecundity and working qualities.

CROSSES OF GOOD SIZE

Cattle produced by breeding native cows to zebu bulls are much larger than the local Arab cattle. The head is delicate and expressive, the eye prominent, but the general appearance is spoiled by the large and ungraceful horns. The neck is short; the zebu

[1] Translated from the *Journal d'Agriculture Pratique*, Paris.

[2] An allusion to American grape vines, by the use of which as grafting stocks, French growers were able to recreate their vineyards after they had been nearly wiped out by phylloxera.—The Editor.

hump has disappeared. The fore-quarters are powerful, the chest deep, the shoulder very oblique, the legs delicate and nervous, the posture good. The line of the back is pretty, the short flank is vaulted, but the rump is sunken. The tail is very fine, long and well attached, the switch is voluminous. All the tissues and bones are fine, the muscles well developed, the belly as small as it could well be. The color is generally light and nearly always uniform.

The half-bloods (zebu x Arab) are much heavier than their brothers of pure Arab blood, sometimes reaching a weight, on the hoof, of 1,250 pounds. With a little addition of European blood through the mother, they can add another hundredweight to this. Butchers are eager for them, the meat being of excellent quality—no matter what has been said to the contrary—and the cut, much greater than that of most breeds, may exceed 60% of the live weight. They usually command a premium at the stock yards.

As work oxen, they are faster, stronger, more enduring than our native stock, but also less docile. A horseman would say that they show more blood. Nevertheless, they do not display a vicious temper to men who handle them.[3] One can break them to perfection by taking a little pains, by castrating them young, by always keeping them up in a stable and yoking them at the age of 2 or 2½ years. They then become first-class draft animals which, at the age of retirement from labor, become excellent beef animals.

They are easily kept in good condition and are always in shape to sell, in spite of inferior nourishment.

The cow has little milk, but no less, I should say, than most of our Arab cows. On the other hand, her milk seems to be very much more nutritious.

ASIATIC RACES BEST

The races of zebu are very numerous, and may be divided into African and Asiatic. Among the African races which have been tested in Algeria and Tunisia are those of Sudan and Madagascar. They yielded much poorer results than the Asiatic breeds. Among the latter, the little Brahmins of Ceylon are the most noteworthy; after them, the Nellores and the Malaysians are the most highly valued.

Zebu crosses, rather recent in Tunisia, have been made in Algeria for many years. In 1865, zebus from the Sudan were sent to the Jardin d'Essai (experiment station) of Algiers, and gave rise to hybrids of remarkable hardiness, which created much satisfaction among breeders. Traces of them can still be found in the coastal plain. Much later —some twenty years ago—M. Rabou of Bône introduced by accident, it is said, little Brahmins which gave even better results. This breed still exists and has furnished Tunisia with the best breeding-stock it possesses. Unfortunately, it is hard to obtain purebred bulls or cows, since they are more difficult to raise than are the grades.

The principal objection which can be made to the use of the zebu in our animal industry is that it is only a temporary expedient, and is not leading to the creation of a new breed. Nevertheless, it must be admitted that it is improving our cattle because an infusion of zebu blood considerably increases their hardiness. At present we see the most enthusiastic admirers of the Swiss and Tarentaise cattle seeking an alliance with the zebu, to give their breeds the quality of endurance which they now lack. The improvement of our cattle by zebus seems to me more practicable than the acclimation of pure breeds from Europe.

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[3] C. L. Willoughby of the University of Florida College of Agriculture (Gainesville), who was formerly in charge of zebu breeding in Georgia, writes: "My understanding and my own opinion of the Georgia work was that it was rather clear that it would pay the Georgia people better to stick to other breeds, rather than waste their time and money on these Indian cattle. We found them bad-tempered and hard to handle, comparatively slow in growing, and poor beef animals and still poorer as milk animals."—The Editor.

THE CATTLE OF BRAZIL

Native Stocks Among the Finest in the World, but Ruined by Indiscriminate Cross-breeding—Introduction of the Zebu and Its Gradual Preponderance—Future of Live-stock Industry Jeopardized by Its Spread.[1]

JOSÉ MARIA DOS REIS

Director of the Model Cattle-breeding Farm of Uberaba, Minas Geraes, Brazil

BEFORE the introduction of the zebu, the bovine population of that rich portion of southern Brazil known as the Triangle of Minas Geraes was made up of diverse races which indiscriminate cross-breeding had brought to a degenerate condition. In spite, however, of this mixture of blood, under the breeding methods of the plains of Minas, Goyaz and Matto Grosso, there were formed, it may be said as a result of natural selection, races of cattle well suited for use in improving the country's live stock industry.

In the Triangle one particular race of local origin attracted the admiration of the whole world in the middle of the last century.

This breed, the ancestors of which are to be sought in old Portugal, is connected with the great Alemtejan race. Crossed with cows of the same race, already modified by Brazilian conditions, there was produced the bull known as the *bruxo* or *junqueiro* or *pedreiro*, or most commonly *franqueiro*.

Produced perhaps in the first place in the Triangle, the junqueiro cattle soon become better known as *Franca* cattle, largely through the influence of European zootechnists who took an interest in our stock-breeding.

In those days this favored zone of the Triangle of Minas, farther towards the interior of central Brazil, did not maintain, like Franca during the time of the emperors, commercial relations with the littoral, which the fame of this ancient city of São Paulo won for it. The Triangle was, then, in that epoch, a zone all but unknown, and when its breeders shipped out their cattle along with the Franca cattle, the junqueiro bulls lost this name in São Paulo, becoming known simply as franqueiro cattle, a name which passed into scientific literature.

CORNEVIN'S DESCRIPTION

It was, then, in Franca that Cornevin found the excellent breed which originated in Brazil and has maintained its specific characters down to the present time. He described it as "a type of great weight, heavy skeleton, long legs, long, coarse, red hair, with more or less pronounced tendencies to orange and canary-yellow; tail short and thick, with a well-developed, close switch, head large and flat, horns formidable."

According to this writer the franqueiro is related to *Bos primigenius*, which became extinct in Germany in the middle ages, while Nehring places it with the later *B. frontosus*, of the commencement of the present geological era.

For the rest, whether or not we admit the relations traced by these distinguished zootechnists, the franqueiro bull of the Triangle has its origin in the brachycephalous breed of the Iberian peninsula, originating in Portugal and introduced to this part of Minas in the last century by Col. João Francisco Diniz Junqueira.

But it is by no means the type which can be considered ideal for Brazilian purposes. There is yet much room for improvement.

[1] Translated from Chacaras e Quintaes, VIII, 1, 44, Rio de Janeiro, July, 1913.

It was necessary that man, keeping his own purposes in mind, should add certain characters to the genotypic composition of the breed, and modify others which were prejudicial to his purposes.

DEFECTS OF NATIVE CATTLE

The skeletal structure was too highly developed, at the expense of the muscular system, and the exaggerated horns prevented it from grazing on low herbs and in hilly country. When it was brought from the interior to the commercial districts nearer the coast, the breeders there immediately demanded that these prejudicial characters be done away with.

The goal, then, was to improve the breed from this point of view, and yet to conserve the high yield of milk for which it was noted. It was recollected, in a moment of inspiration, that the Amaro Leite breed of the Goyaz plains presented striking contrast to the franqueiro race, and it was believed that a cross might introduce a heterozygous equilibrium of characters, producing a race of grades which would be well worth breeding. The attempt was highly successful.

From this cross resulted the Caracú.

Such is the origin of this famous Brazilian breed, as understood by us here in the Triangle.

No other origin is possible. But we know very well that among those who have studied the Brazilian races of cattle, there is nevertheless a controversy over the origin of this breed. Some hold that it comes from the province of Ceará, having as its home the village of Acaracú, whose name in a corrupted form now designates the breed in question; others reasoning from similar premises, declare that it comes from the remote and ancient city of Kara-Kul in Central Asia, and that the progenitors of the Brazilian breed were brought from there in our colonial period.

THE CARACÚ A HYBRID

The positive fact, however, about the origin of this breed in our Brazilian ranges is that it resulted from a cross between the Junqueira and the Amaro Leite breed, which latter we call *curraleiras* and which, like most zootechnists in Brazil, we believe to be derived from the old dolichocephalous animals of Aquitania.

Thus it is that we possess in the Triangle these two types of cattle, which we believe to be the best in the world for the particular requirements of our native live-stock men. Nevertheless, this breed which our ranchers already possess, endowed with such excellent economic qualities, is yet susceptible of great improvement in the manner demonstrated by Bakewell and Colling,[2] since it cannot maintain itself and preserve its primitive characteristics without variation.

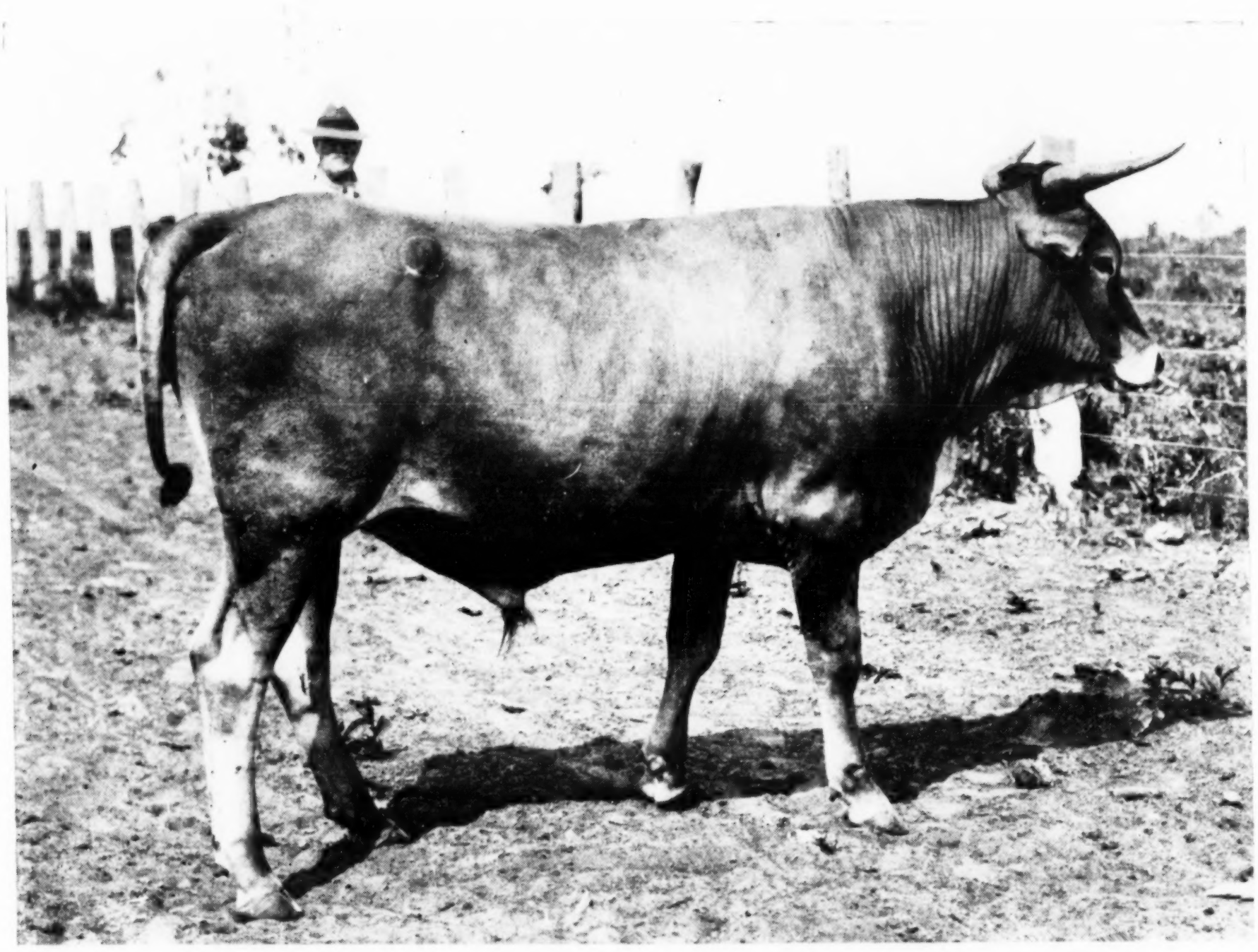
In our imprudent haste to improve it, we have allowed it to degenerate through cross-breeding with the Nile cattle brought to Rio Janeiro for the first time in 1826 and later spread through the fazenda of Sr. Azarias de Souza Dias at S. Antonio do Machado, Minas, and afterwards to Lavras do Funil and eventually to our own zone. Carried away by enthusiasm for the first generation of this cross, which showed the vigor common to all F_1 hybrids, our breeders thought the problem was permanently solved, ceased their efforts and went to sleep happy over the success of their undertaking.

In this foolish over-confidence, in their house on foundations of sand, whose impending fall they never foresaw, the fact that they were crossed with a heterozygous breed of doubtful origin never troubled them.

THE CHINA CATTLE

After the Nile, the China came to pour its blood into the mongrels already in existence. The arrival of this breed dates from 1855. Its Brazilian origin was a bull imported in that year by the Baron of Bom Retiro. According to a tradition reported by some, who believe this breed is really the zebu, it took its name from the fact that it arrived synchronously with a shipment of Chinese coolies whom the same baron had imported for work on his plantation. It is thus, then, with the crossing

[2] *i. e.*, by inbreeding.—The Editor.



THE CARACÚ, FAMOUS NATIVE BREED OF BRAZIL

Its origin is said to have been in a cross between two earlier native breeds, and it is here represented by a yearling bull. The caracú breed, although still capable of improvement, is considered by experts to be admirably adapted to its environment; it also lends itself well to crosses with improved beef breeds such as the Shorthorn and Hereford. In some parts of Brazil, however, it is being displaced altogether by zebu hybrids, which are preferred because of their vigor and hardiness, and ability to travel on foot long distances to market. Photograph from Murdo Mackenzie, São Paulo, Brazil. (Fig. 5.)

and recrossing of types heterozygous from their origin, and the mixture of mongrels of all sorts, that the patient and hard-working breeder on our ranges brought together the product of all this aimless hybridization and saw with extraordinary surprise that the beautiful F_1 type which once graced his ranges now played a very small part in the mixed cattle of the country.

The Brazilian cattle then entered on a period of free and rapid degeneracy.

Breeders began to take alarm, and tried to remedy the difficulty, which constantly increased.

In this period of anxiety, brought about by the existence of such serious evils, they again began, as at first, without aim, without definite plan or theoretical guidance, to attempt new experiments, certain that they would at once find a remedy for the trouble.

They took the route that seemed the easiest—that of introducing ameliorative factors. They forgot, in their stupor, the evil occasioned by past hybridization, and ran after Shorthorns, Devons and other fine types representative of the best European breeds.

The failure was enough to take the heart out of anyone.

Poorly equipped, by lack of knowledge of the genetic constituents of the breeds they were introducing; not having proper foods, not counting on the influence of environment, accustomed to the easy and economical conditions of breeding which existed in the huge herds of the interior, they assisted, disheartened, the gradual extinction

HALF-BREED ZEBU COWS AND HEIFERS

This herd represents the mixture of zebu and native Brazilian blood. Although thousands of zebu cattle have been imported to Brazil, they are rarely bred pure, but are crossed on native cattle to produce grades. The same attempt is being made in the southern United States, in order to give range cattle the advantage of the zebu's immunity from the dreaded Texas fever. Not only is the zebu immune to this, as far as is known, but it appears to be highly resistant to foot-and-mouth disease as well. It therefore offers valuable material for scientific breeding; but its full possibilities are not yet as well known as they should be, because little of the breeding hitherto done with it has been scientifically conducted. (Fig. 6.)

of these new arrivals, supposed to regenerate the herds depreciated by centuries of lack of attention and careless intercrossing.

NATIVE STOCK RUINED

The finest junqueiras, the excellent caracús that were able and are still able to regenerate the cattle industry of the Triangle, were dragged deeper and deeper into ruin by hybridization with half-bloods, with Niles and with Chinas. The latter breed according to some genetists is derived from the Albion; by others its name is derived simply from the old castilian word Chino or China, which means mongrel; by still others, its domain is said to be ancient Asia.

What, then, was the value of the appearance in this *mare magnum* of misfortune, of admirable individual types of these beautiful and useful national breeds, if stockmen did not know enough to utilize them by selection and line-breeding? In the greed with which they sought salvation, they looked only for a remedy with immediate effects. Selection was slow, and perhaps they did not wholly believe in the extraordinary results accredited to it.

The day of native cattle was about over. Those fine representatives, junqueiras, caracús, curraleiros, etc., inured to the environment, with good and fixed qualities which could be transmitted through successive generations, were relegated to the background and gave place to the zebu, which, like the Nile and the China, reigned in majesty in the vast and lush pastures of the territories of Minas.

Without the beautiful and useful qualities which ornamented our national breeds, the zebu conquered them, for a time, principally by its wonderful hardiness and its aptitude in acclimating itself to our native ranges—as if 400 years of abandon were not enough to prove that our native stock had such a hardiness, too!

All native stock in the Triangle, which has not yet been mixed with Indian blood, is heavy, healthy, strong in the yoke and resistant to diseases, gentle and rich in milk. In spite of the neglect to which they have been subjected, it is not rare to find specimens of our native breed—that breed which R. Endlich has called the finest cattle in the world—with a weight of 100 arrobas (*i. e.*, 3200 pounds), and magnificent caracús, such as beat the record at the exposition held in Uberaba, where hardly fifteen specimens of this breed, raised locally, were shown, as against 400 Indian cattle, coddled in succulent pastures under the vigilant eyes of their owners.

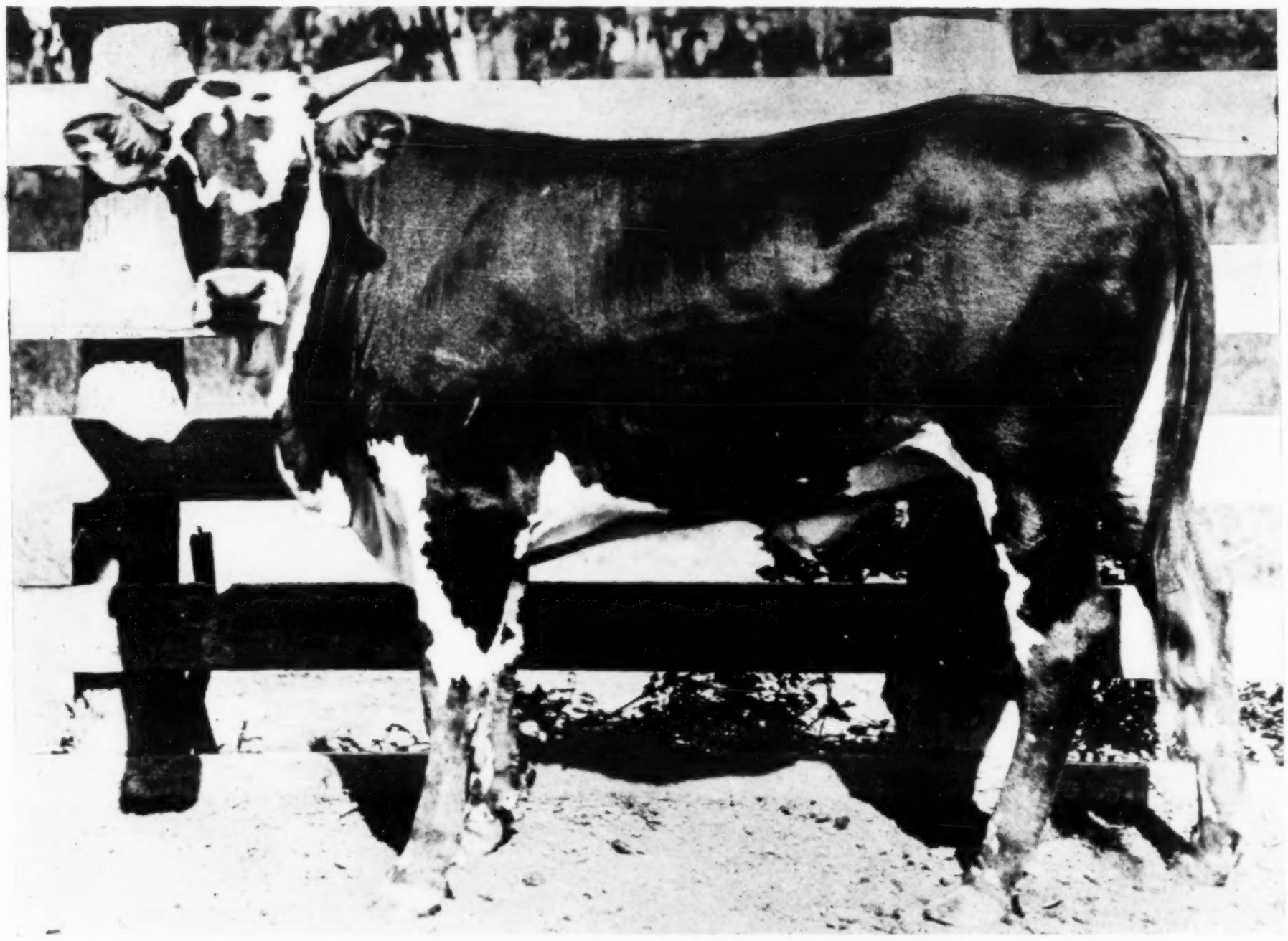
INTRODUCTION OF THE ZEBU

Aside from weight, the caracú is reputed an excellent worker, and is considered to be the best bull for work—superior to the zebu. However, the breeder of the Triangle, in spite of the unhappy experiments made with the best European races and the evils occasioned by crossing with Niles and Chinas, as we have already seen, disregarding his own home breed, introduced for the first time in 1889 representatives of *Bos indicus*, the idol of the banks of the Ganges, to the pastures of the future stock breeding zone of Minas Geraes.

It must be admitted that the crossing of this race has brought a certain prosperity to the breeding industry in the Triangle of Minas, since the grades have been sold for good prices. Forgetting, perhaps, the results obtained with crossing other breeds in the past, the breeders, encouraged by the good returns of this new venture, think that they have attained the desired end in regard to the perfecting of a breed for local use, and are now gathering the first fruits of the harvest like the victors of a crusade.

It is yet too early for this.

Questioning one of the largest breeders of this region as to the reason for himself and other breeders preferring the zebu to any other race, he replied as follows: "This region being essentially one for stock raising, and our ranges being occupied by various breeds of milch cattle in a state of degeneracy, we hope to improve the present state of affairs through crossing. We prefer to attempt this by means of the zebu, because we



ZEBU-HEREFORD CROSS IN TEXAS

This half-breed heifer, weighing 1000 pounds at 12 months, was bred on the ranch of A. P. Borden, Pierce, Texas, and allowed to graze all summer on a range infested by the ticks which carry Texas fever. She was never dipped or protected against ticks in any way, but at the end of the summer showed no trace of infestation. It is such cases as this that have led genetists to foresee in the zebu the foundation of a new breed of cattle for the southern United States. Photograph by the Bureau of Animal Industry, U. S. Department of Agriculture, November 18, 1911. (Fig. 7.)

have proved that the grades produced by this cross possess the following characters: weight, facility of acclimation, hardiness and fecundity.

FECUNDITY OF THE ZEBU

"We have observed that the descendants of the pure blooded zebus imported in 1889 breed with facility in our ranges, even in seasons of drought, resisting all sorts of weather.

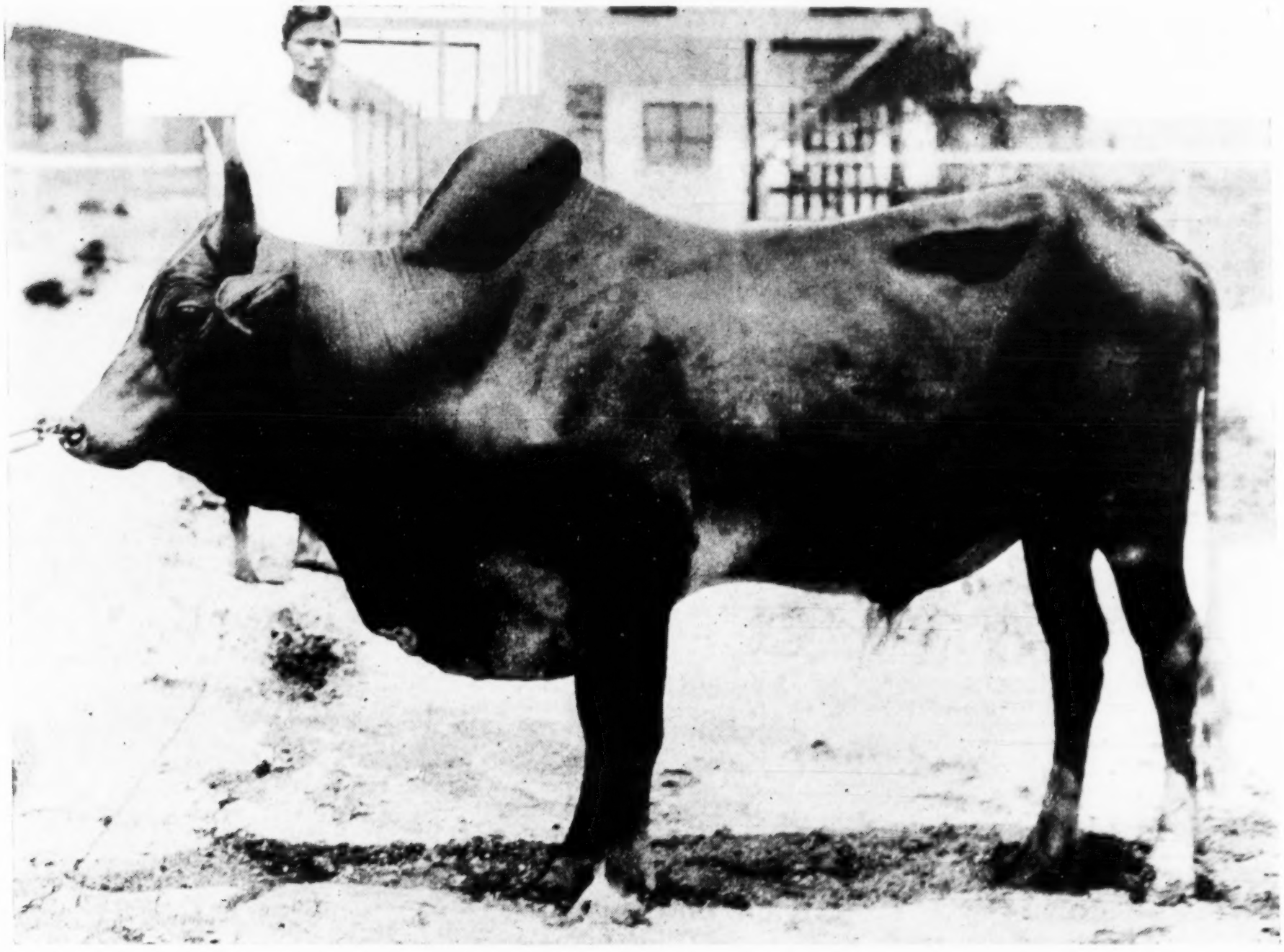
"The zebu bull allowed to run loose on the range will produce from sixty to seventy calves, in a period of four to five months. The heifers rarely fail to produce their first calves at three years of age. We have had a grade cow give birth to two calves inside of ten months and six days. The calves are strong, like all crossbred cattle, and the rate of mortality, compared to that of the breeds formerly raised here, is extremely low.

"The development of the grade and its facility for fattening are such that steers 3 years old are ready for butchering and are preferred to any other race by everyone who handles them, from the buyer on the ranch to the butcher who offers for them the highest market price. At 5 years the hybrids average from 650 to 700 pounds in net weight."

Two particular races of the zebu are preferred; the Nellore and the Gujarat; the former with small ears and the latter with ears well developed.

In this latter, the preference is interesting.

For all the grace, beauty and weight of the Nellore race, it is always worth



A STRANGE ZEBU HYBRID

Mestizo bull in the Phillipines; a cross between zebu bull and Batanese (native) cow. The front half of the animal is wholly zebu in character, the dewlap and hump, which are the particular property of the Indian breeds, being represented in perfection. The hinder half of the animal is wholly characteristic of the native stock of its mother (note sheath and rump). Photograph from the Bureau of Agriculture, Manila, P. I. (Fig. 8.)

less money than the angular progeny of the large-eared Gujarat.

Zootechnists, who have transformed the internal machinery of cattle in order to make them yield more profit to their owners, have entirely ignored that common appendix, the ear: yet it is the criterion by which admirers of the zebu rate the value of the animal—its length or shortness determines the high or low amount of the price.

The breeders of this race of cattle value an ear more highly than the juicy steak of a short-eared caracú.

They say that the zebu without large ears is not a zebu, and the native of the interior advances that reason, as he refuses to buy it.

MENDELIAN SEGREGATION

Among the breeders of this municipality, it is a matter of common observation that native characteristics are wholly bred out and zebu characters entirely dominant in hybrids after the fifth generation. In the fourth generation they get a type which they call purified, resulting from a cross of a pure type with a seven-eights cow. The crossing of a purified with a pure blood is that which they accept as a pure national type, the "Zebu of Minas."

However, at present this race is not yet established. Whether the breeder breaks it up in the sixth generation by crossing back to pure zebu, not realizing that the introduction of this pure-blood anew is equivalent to another hybridization; or whether the *Bos indicus* undergoes actual degeneration; the fact remains that the pure Minas race of zebu has never yet been fixed.

The latter explanation seems more acceptable, because the renovation of

blood in this breed is frequent. Perhaps the breeder does not succeed in fixing a race of definite type such as we have just described, because he is obliged constantly to breed a certain saleable type of cattle, and therefore resorts to constant out-crossing to get it, bringing in new Indian blood in every generation. The result is that a distinctly local type of zebu is never fixed, because it is always upset by a cross back to the imported stock.

The herds and herds of breeding stock coming steadily from India to the ranges of Minas prove this assertion.

The advantageous cross is the commercial cross: that is, to sell and resell the hybrids for slaughtering. Cross-breds of this type range from one-half to three-fourths blood; they are the heaviest hybrids. Beyond this cross, the Indian rapidly loses his weight.

The contrast here between *Bos indicus* and *B. taurus* is striking. While in the latter, greater weight, precocity, etc. are gained by selection, in the former a steady loss of weight takes place, together with an extraordinary reduction in height.

THE ZEBU PREPOTENT

The zebu originates in an ancient, thoroughly fixed race. Due to the hereditary potency of the ancient Indian race, the types produced by its cross on the native cow faithfully reproduce all the characteristics of the foreign race.

The zebu is an absorbing race, and by this property has caused the complete disappearance of the Brazilian race in the fifth generation.

Under these conditions, scattered here and there, as we find them, throughout Brazil, by the commerce in halfbloods, for butchering and breeding, and with herd after herd coming from India—it is certainly desirable that the government should give serious attention to the study of this type of cattle so that in the future we may not find our hands full of difficulties, even greater than those offered by our old race of mongrels.

In the municipality of Uberaba, which comprises barely 9,314 square kilometers of the vast zone of the Triangle, and 7,451 square kilometers of this under cultivation to the native grasses *jaragua* and *gordura*, the number of cattle was in the years 1908-9, according to Dr. H. de Araujo Pontes, 83,043 head, of which 1,012 were pure zebus, 37,174 zebu hybrids, 12,477 caracús, 30,913 Chinas, 1,378 curraleiros and 186 Turinos.

In twenty-four years—the time that has elapsed since the introduction of the zebu—one can easily see that in a small and insignificant part of the interior region, this breed has greatly increased in number and the native breeds have lost ground. From this one can easily understand the absorbent power of this breed, which if it continues as it is now going, in a short time will give us not a better race, but a new race, to replace the old one. We will have changed the race, perhaps, for the worse. There are no scruples about this breeding experiment.

The zebu has been crossed with every one of the hybrid races of our cattle which I have referred to.

In this indiscriminate hybridization, to right and to left, bulls constantly arriving from the orient ostensibly as purebloods, but without bringing any certificate of registry, are being bred to every grade of our own hybrids.

DANGER TO THE INDUSTRY

It can be verified from this that, in spite of the relatively short time since it was introduced, this breed will lead more quickly than any other to the complete ruin of our native stocks, through degeneracy, if energetic precautions are not taken to forbid breeders to make such crosses.

It is a great evil which we must avoid, and one which, unhappily, is increasing, speading to the far-away prairies of Goyaz and Matto Grosso and even to Rio Grande do Sul, where only a year ago 1,500 breeding animals of all grades of blood were exported from one municipality.

Even with pure-blood bulls brought directly from the province of Gujarat in India, degeneration is manifest in the third generation, to such an extent that breeders are constantly obliged

to change the leadership of their herds.

Imagine the results of crosses between the hybrids!

The products of the first cross between zebus and junqueiras or caracús are the best types. They are strong, heavy animals with great hardiness under all conditions, thrive on any kind of pasture and are excellent under yoke.

As to the quality of the beef, current opinion is that it does not lend itself well to the dried-beef industry, because its tissues do not contain as much fat as do those of the caracú and other good races.

The flesh of the zebu is fibrous, particularly when there is only a small amount of native Brazilian blood in the crosses.[3]

For this reason, and also because of what has previously been said, the flesh of the Indian cattle is of poorer flavor than that of our breeds—especially that of the franqueiro race, which R. Endlich claims is the best producer of high grade beef. The zebu has not a large skeleton—particularly hybrids with Nellore blood. Steers from the crossing of this race with the two superior native races at four years attain an average weight of 700 pounds. The hybrids of greater proportion of zebu blood are much lighter—an indisputable proof of the speedy degeneracy of *Bos indicus*.

LOSS OF MILK YIELD

In general the crossing of the zebu with our cattle makes the latter lose a large part of its milk producing qualities. The first period of lactation of the hybrid zebus is at the most ninety days after the birth of the calf; from then on, due to the new gestation, the cow commences to diminish in milk considerably, having weaned her calf at six months. As for the annual production of milk, it is difficult to determine it in these grade cattle, because of the reasons already set forth and because zebu breeders in the Triangle pay little attention to matters connected with dairying.

The hybrid zebus in general are bad milkers, and rarely allow themselves to be milked. They are wild, and if tamed at their first calving, soon lose this domesticity and have to be tamed again at each calving.

This is a laborious proceeding which completely prevents dairying if the cattle are of Indian blood.

Many hybrid zebus have the yield of milk so little developed that they are unable to raise their own offspring. This is, then, outside of the defects such as wildness, rapid degeneration and lack of milk, a serious defect that this race is instilling in our native cattle.

We must take strong measures to oppose this steady ruin of our native cattle, which is fast becoming a race of scrubs through indiscriminate cross-breeding without scientific guidance.

It is an interesting phenomenon.

Withal, if the crosses between grades should result in a fixed race, without the inconveniences of frequent reversions and without having to commence breeding operations from the beginning, all over again, every few generations, the Indian cattle would be good types both for commerce and for beefing, particularly having in view the great distances that separate the pastoral zones of Goyaz and Matto Grosso from the littoral, where the cattle are slaughtered.

But the solution of this problem seems to us very difficult in such a manner—particularly with this stock.

The reasonable, certain, and economic solution is that which our government is trying to give to the case—founding establishments to carry on systematic selection with our marvelous native races of cattle.

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[3] Murdo Mackenzie of the Brazil Land, Cattle and Packing Co., São Paulo, writes me: "A characteristic of the zebu is that it produces almost entirely dark meat with little or no fat mixed with it, and this is the kind of beef the natives prefer, but it is not suitable for exporting to Europe or America. You will notice from the conformation of the zebu's head that it is lacking in brain development. It is narrow between the eyes and has a long, narrow, keen head and face, which shows that it has not the brain development of either the Shorthorn, Hereford or the other beef breeds. The natives of this country are fond of the zebu hybrids because they are good travelers, and as nearly all of the cattle are transported on foot, this seems to be quite a factor to their minds. When the cattlemen of this country commence transporting their cattle by rail rather than by foot they will see the necessity of breeding cattle for better beef."—The Editor.

XENIA IN FOWLS

Experiments to Determine Whether Cock Has Influence on Color and Form of Eggs Laid by Hens to Which He Is Mated—Belief Seems to be Without Solid Foundation.

A Review of Some Recent German Work

XENIA is the name given by Focke in 1881 to designate a curious feature of hybridization in plants: the direct influence of foreign pollen on the seed produced. Popularly, its meaning has been extended to describe any direct influence on the fruit as well as the seed. Such influence has been a part of farm lore for centuries. The farmer has attributed the bad quality of his watermelons, for example, to the fact that they were pollinated by pumpkins grown in an adjoining field. With the increase of knowledge of what was actually accomplished by pollination, and what the actual process of reproduction was, it became clear that most of these beliefs were little better than superstitions. Genetists decided that the watermelon could not be deteriorated by pumpkin pollen, because that pollen could have no effect on the fruit resulting from the flowers it pollinated. What actually happens is that the germ-cell of the pollen grain unites with the egg cell of the other parent, and the essential parts of the two lie side by side in the resulting seed, not even fusing. It is not until this seed is planted, grows and matures its own seed, that the original heredity-stuff of the parents is shuffled, recombined, and given a chance to express new characters or make combinations of old ones.

Pollen, therefore, in the nature of things, cannot ordinarily have any *immediate* influence on the fruit produced. But certain exceptions—reported for two centuries by farmers and breeders, first examined by Focke, and later well attested by many observers—have been found, the best example being in maize. When a race of white maize is crossed with a variety bearing black ears, the seeds produced should all be white. The black father would not show its influence until these seeds were planted and produced ears in turn. But xenia interferes, so that the seeds of our original pollination, instead of being white, actually show the effect of the black parent—they will be splotched or, in many cases, wholly black. Speaking figuratively, xenia seems to leave the pollen parent always one lap ahead in the race. The parental generation shows characters that would not ordinarily be expected until the F_1 generation; the F_1 generation shows characters that would not ordinarily be expected until the F_2 generation; and so on.

XENIA IN PLANTS

Here was a mystery that puzzled plant-breeders for some years. Similar phenomena were found in rye, buckwheat, and other plants. The mystery was finally cleared up by Nawaschin and Guignard (1899) and Webber, De Vries and Correns (1900), who found that it could be explained very simply from a knowledge of the cell mechanism. There are two nuclei in the pollen cell and two in the egg cell. The principal nucleus of the one unites with the principal nucleus of the other to produce the embryo; the secondary pollen nucleus unites with the secondary egg nucleus and produces the endosperm or starchy part of the seed. The immediate influence of the pollen parent is therefore naturally to be expected in the endosperm, and will be visible, in general, whenever the differences between the two parents are of a striking nature—black and white, in this case. In ordinary pollination between plants of like characters, an influence is produced by the pollen parent on the endosperm, but is

not of a nature to show itself. The phenomenon of xenia in the plant world, then, is a perfectly simple and natural one, is dependent on the double fertilization described above, which occurs in all flowering plants, and may be expected to be visable whenever the differences between the two parents are of a nature favorable to its observation.

There is always the hope in genetics that what is found to be true of one section of the organic world will be found to hold good in all. If xenia occurred in plants, it or something like it might be expected in animals. Accordingly, phenomena of similar nature in the animal kingdom were sought.

An attempt was made to connect xenia with telegony,[1] but the analogy does not seem to be very close. There is, in fact, a fundamental difference, for in xenia we have an actual union of two cell-nuclei, while the supposed effects of telegony have been accredited to an interchange of blood, or some more mystical and less definable cause. Telegony is now dead, in scientific circles, while plant xenia is more alive than ever.

If it could not be traced in mammals, it might be traced in fowls. It has long been believed by some people, though not by most naturalists, that the eggs laid by a hen are influenced, as to size, shape, color, by the cock with which she is mated. An attempt was made on numerous occasions to show telegony in this connection, but the case was very weak. Then it was decided, by a certain set of investigators, that here was the long-sought case of xenia in the animal kingdom.

From this standpoint the question has been debated with considerable warmth during recent years, principally among German biologists. Obviously, there are two parts to the discussion. First, does the alleged influence of the cock on the appearance of the hen's eggs really exist? If it does not, there is an end of the dispute; but if it does, we can go one step farther, and try to explain it. If it exists, is it a phenomenon similar to xenia in plants, or must it be explained in some other way? The latter question may be set aside until we have considered whether there is any evidence of this paternal influence on hens' eggs.

XENIA IN POULTRY

The first observation on record by a man of science seems to go back to W. von Nathusius (1867) who reported the case of a supposedly pure bred hen, of a breed that always produced white eggs. She was mated to a cock of the old Cochin China breed, which produces brown-shelled eggs, and some days later she began to lay eggs with yellowish shells. This influence disappeared very gradually; even after months an occasional dark egg appeared.

Such evidence, of course, counts for little with the modern biologist, who has become more critical than a jury lawyer as to what he accepts. There were a dozen ways in which the facts, if such they were, might be explained, and as there had been no "control" of any kind, there was no means of knowing that the yellowish color of the eggs was not due to something in the hen's food, or to any one of numerous other exterior or interior causes, quite independently of the Cochin China cock. So an attempt was made to gather evidence of greater "evidential value" by carefully planned experiments.

Plymouth Rocks, a breed well known to lay brown-shelled eggs, were chosen by Professor P. Holdefleiss[2] of the University of Halle for this purpose, and mated with a Leghorn cock, whose breed produces eggs of a pure white. "The eggs showed a series of colors from dark brown to white. Some of the medium brown eggs showed white flecks. Some of the dark brown were

[1] The principle of telegony "is that females are *impregnated* by the first males to which they are bred, so that all their subsequent offspring, regardless of their actual father, will show influence of the first male." See "Telegony," by Dr. Etienne Rabaud, Journal of Heredity, V, 9, 389-399, Washington, D. C., September, 1914.

[2] Holdefleiss, P., in Ber. aus dem physiol. Lab. u. der Versuchsanstalt d. landw. Inst. d. Univ. Halle, 20 Heft, 1911, S. 93-111; also in 25 Flugschrift d. D. Ges. f. Züchtungskunde, Berlin, 1913.

EFFECT OF XENIA IN GRAIN OF CORN

This grain of maize was produced by a pure white strain, which had been pollinated from a red variety. In general pollen has no *immediate* visible effect on the characters of the resulting fruit, but it is now known that it does produce an effect on the endosperm, or starchy part of the seed. This effect, which is known as xenia, can be easily seen in the dark-colored blotches and splashes sprinkled over the seed, just under the translucent, seed-coat. (Fig. 10.)

perhaps unfertilized." Holdefleiss had the courage to enunciate the following conclusions:

"1. The color of egg shells shows, after fecundation of the hen by a cock of some breed other than her own, the influence of the paternal strain; there is, therefore, evidence of xenia.

"2. The shell of a bird's egg is not exclusively a product of the maternal parent, but is also acted on by the cells formed after fertilization. The material which goes into it, however, is furnished by the mother's body.

"3. The color characters of the egg shell segregrate in the following genera-

tion (F_2) according to the 'pea type' of Mendel's law, in the proportion 3:1."

EVIDENCE IS EQUIVOCAL

As Walther, who critically reviews the evidence, says, "The conclusion in this last case does not fit the facts very closely. What, in the first place, is the 'pea type' of heredity? It is that method in which, at the crossing of organisms differing in *one* pair of *non-blending* characters, the first hybrid generation shows a complete concealment of one (the recessive) character by the other (the dominant one), while the second generation shows the proportion of three dominants to one recessive. And just what results did Holdefleiss actually secure? In the first generation (to which he considers the shells of the eggs belong, from which the hybrid birds of the first generation will be produced) *both* characters of the parents (*i. e.*, brown and white) appeared, together with an intermediate form which had not previously existed. For the purpose of demonstrating his xenia he picks out these intermediate eggs, which are impossible in the 'pea type' of heredity; for the purpose of demonstrating the pea type of heredity, he depends on the brown eggs, which he himself admits are of no significance for xenia, because likely not to have been fertilized. In the second generation (by which he designates the eggs laid by this first generation), instead of the *brown* and white eggs in the proportion of 3:1, which calculation on the basis of Mendel's 'pea type' of inheritance required, he got two brown, 119 brownish or intermediate, and forty white; whence he concludes that 'brown showed itself to be the dominant character.'"

If this is the fate of Holdefleiss' third proposition, it is evident that his second one is on soft ground; and the first one, that xenia actually did exist, is far from proved, considering the number of possible explanations that might be made.

Domestic fowls are not an ideal material for genetic experiments, because of the fact that they are all more or less hybrid in origin, and their appearance gives little idea of what their germ-cells actually contain. Armin von Tschermak,[3] professor of physiology in the Veterinary High School of Vienna, attempted to throw light on the question by breeding canaries and finches, closely related species of wild birds which might be expected to be purer in genealogy. English or Harz canaries were mated partly with males of their own kind, and partly with males of five different wild species. As a control, unmated canaries were allowed to lay eggs that had not been fertilized at all. The results of the experiment, as described by its author, may be summed up as follows:

Changes in the form of the eggs, as a result of paternal influence, could be seen in only two cases, and these are questionable; therefore no weight is attached to them.

CHANGES IN PATTERN

There was no change in the ground color of the egg shells. The pattern is made up by two pigments; light brown and dark brown. Alterations of the light brown pigment were slight, but in the direction of paternal influence. The dark brown pigment, on the other hand, showed modifications that cannot be questioned. "They are so clear, that an experienced eye can tell at a glance what the paternal species is, in each case. . . . As to the occurrence of xenia in the coloring of bird's egg shells, there is no longer room for any doubt. . . . The hybridization, in the cases here analyzed, has exerted a specific influence on pigment formation in the egg shell."

The unfertilized eggs of unmated female canaries were then compared with the fertilized eggs of female canaries mated with males of the same species. The former were found to be slightly smaller, and almost lacking in

[3] See Biol. Centralblatt, 30 Band, 1910, S. 641-646 and Arch. f. die gesamte Physiologie, 148 Band, 1912, S. 367-395. The author is a brother of E. von Tschermak, the distinguished Austrian plant-breeder who with Correns and De Vries was one of the rediscoverers of Mendel's work, in 1900.

pigmentation. This gives the experimenter further ground for the belief that the formation of pattern on the shell is connected with and influenced by fertilization.

Assuming for the moment that this conclusion is well founded, that we actually have xenia or something like it in birds, how could it be explained? Whichever way we turn, we run against generally accepted principles of biology that we can not avoid: it is this fact as much as the lack of adequate experimental evidence, no doubt, that makes the average biologist incredulous about the whole idea. Two possible means of explaining an influence of the male in this connection are suggested by von Tschermak. The first he calls an "intra-oval xenia-reaction," meaning that the effect of hybridization on the egg shell is an effect produced by the embryo —that is, in the last analysis, an effect of a single sperm. The second method is "extra-oval xenia-reaction," which supposes that the effect is produced by the influence of the whole quantity of sperms on the maternal uterus.

The first hypothesis seems to von Tschermak to be simple and acceptable, but most readers will probably share the feelings of Walther, who remarks: "An influence that goes in a very short time, partly through the yolk and always through a surrounding body of unorganized albumen, through the entire shell, and demonstrates its presence on the very outside layer of this shell of lime and—this is a point that I think has not been sufficiently emphasized—only on this outside layer of shell: certainly no one can form even the slightest conception of how such an influence could originate or exert itself."

ONE SOURCE OF ERROR IN EXPERI

Photograph by the Bureau of Animal Industry, U. S. Department of Agriculture, showing ra during recent years show that the eggs of any individual hen tend to become a little sm believed, is likely to be a dwarf, such as is shown at the right in the above photograph: th however, the eggs of any individual fowl usually vary only slightly from a certain average v matter determined by heredity. But the wide range of variation in weight of eggs in a fl one who is conducting experiments on the subject make constant use of trap-nests and rec

To most biologists, the second hypothesis will seem little better. There is, however, a small amount of evidence now accumulating,[4] which indicates that the sperms which do not play any direct part in reproduction may survive for a time and possibly exert some

[4] See Kohlbrugge, J. H. F., in Ztschft. f. Morphologie u. Anthropologie, 12 Band, 1910, S. 359-368, and in Arch. f. Entwicklungsmechanik, 35 Band, 1912, S. 165-188.

influence of some kind on the maternal organism; and Walther expresses himself as willing to entertain such an idea as a working hypothesis, at least.

CONTRADICTORY EVIDENCE

But perhaps this discussion of how xenia takes place in fowls is really beside the mark—because it may not really take place at all! Until von Tschermak's experiments with canaries have been substantially repeated by other investigators, and have withstood a critical examination by some one able to speak with authority, this small amount of evidence can not be given great weight. It would not be entitled to very much consideration even if it were uncontradicted; but it is in part contradicted, and directly contradicted, by experiments of Professor A. R. Walther of Giessen,[5] which appear to have been made with a great deal of care, and to have been analyzed by sound mathematical methods.

Walther's conclusions are based on examination of 630 eggs laid by thirteen hens. His method of operation was to cross races differing not only in egg-shell color, but in size—that is, bantams and ordinary fowls. Every egg laid was incubated, and if it was found to be infertile, it was thrown out, a possible source of error thus being avoided. As was pointed out above, Holdefleiss' results are of little consequence as a proof of xenia, partly because there is reason to believe that many of the eggs he examined had not been fertilized at all, and from such eggs it it is obvious that no evidence about xenia—the influence of fertilization—could be expected. They might, however, be covered by von Tschermak's second hypothesis's described above.

EXPERIMENTS WITH HENS' EGGS

owing range in size of eggs from a single flock of hens, all of the same breed. Experiments little smaller, as she approaches the end of her laying period; and the last one, it is generally raph: the small size of "pullets' eggs" is also a matter of common knowledge. On the whole, average weight, and the experiments of the Rhode Island Station indicate that this weight is a ggs in a flock of one breed, graphically shown in the photograph, renders it necessary that any s and records—otherwise he is likely to draw some wholly erroneous conclusions. (Fig. 11.)

The points taken into consideration by Walther were (1) the weight, (2) the shape, (3) the glossiness, and (4) the color of the eggs. It will not be worth while to quote Walther's statistics, but his own conclusions may be indicated.

1. It could not be found that the cock produced any effect whatever on

[5] Walther, Adolph R. Ueber den Einfluss der Rassenkreuzung auf Gewicht, Form, Glanz und Farbe der Hühnereier. Landwirthschaftliche Jahrbücher, XLVI, Heft 1, S. 89-104, Berlin, 1914.

the weight of the individual eggs laid by the hen. Such slight changes as were noticed can be explained by the fact that the weight of a hen's eggs tends to diminish toward the end of her laying season.

2. It could not be found that the cock produced any effect whatever on the form (proportion of length to breadth) of the eggs. Walther says that the weight and length of an egg are very closely correlated, so this result is only what would be expected from result No. 1.

3. The glossiness of surface of the eggs did not seem to be at all affected by the cock. This is not such a critical case as some of the others, because the differences in glossiness of the eggs of the pure races used in the experiment are not so great and sharply distinguished. As far as it goes, however, the examination of this point utterly fails to show any trace of xenia.

4. As to the influence of the cock on the color of egg shells, the experiment was not entirely conclusive. It was started with another purpose in mind, and sufficient care was not taken to choose breeds of fowl that were sharply distinguished in the color of their eggs. The results, such as they are, tell against rather than for an influence of the cock on the color of the egg shell, but Walther does not claim that they are final.

THE CONCLUSIONS

In conclusion, Walther says: "The study of the question whether the male bird is in a position to influence the egg shell characteristics in the direction of those that mark his own breed or species, was taken up to determine the accuracy of the investigations previously mentioned, purporting to show that xenia occurred in the animal kingdom." As far as Holdefleiss' results are concerned, Walther thinks they are hardly worth considering. As for the results from von Tschermak's crosses of canary species, Walther says, "My own results have contradicted them, as far as size, shape and glossiness of the eggs is concerned, showing not the slightest trace of influence on the part of the cock. For the question of influence on the *color* of the egg shell, my researches unfortunately are not in a position to throw much light. I think that both these alleged cases of xenia in birds' eggs are from every point of view utterly unsafe grounds for drawing any sweeping conclusion."

Few biologists would be likely to dissent from Walther on this point, that no sweeping conclusions should be drawn from this evidence; and Walther's own results must share the same fate. Von Tschermak's experiments with canaries must be regarded with respect until they are contradicted or explained away, but the evidence of xenia in poultry is certainly not adequate. American poultry breeders do not, on the whole, entertain a belief in xenia in their flocks, and as far as the present evidence is concerned, their skepticism seems to be justified. The question is a recent one, and much work may yet be done on it, but until such work is done, xenia in fowls must be considered an open question, at most.

Barred Pattern in White Fowls

In the note at the bottom of page 149, Journal of Heredity, April, 1915 (Vol. VI, No. 4), it is stated that "Further analytic breeding proves that this barring is carried in the germ-plasm of the White Leghorn, not the White Plymouth Rock." The last line should have read, "of the White Leghorn as well as the White Plymouth Rock."

MORE "EUGENIC LAWS"

Four States Consider Sterilization Legislation and Nine Contemplate Restrictions on Marriage—None of Proposed Laws Satisfactory from Eugenic Viewpoint

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LEGISLATION is still, in the minds of many people, a panacea for all the biological ills of the nation, and the past winter has seen another crop of proposed "eugenic laws," of a character which the experiences of recent years would lead us to expect. Most of the measures which the public hails as eugenic have nothing to do with eugenics, and some of the measures that bear on eugenics bear in the wrong direction. The popularization of the science of eugenics has suffered in the past in two ways which are direct antitheses. On the one hand it has been declared a fad, the dream of the idealist, the impractical propaganda of the mentally unemployed, while on the other hand it has been made the refuge of that species of crank who always welcomes the new and unusual, and a cloak to be thrown about weak legislative measures requiring the sustenance of popularity. Eugenics is a science. It is a fact, not a fad. It is a means for the continued betterment of the race stock and the physical and mental uplift of mankind in general. In order to achieve success, a knowledge of its principles must be disseminated and it is important that those interested in the furtherance of eugenics should understand the exact nature of these measures in order that, if they see fit to favor them, they may not do so under the impression that they are furthering the cause of eugenics. With the assistance of the editor of the Journal of Heredity, there has therefore been prepared the following digest of bills advertised as eugenic, which, as far as we know, are now pending in the several States of the Union.

Bills for the sterilization of certain supposedly undesirable classes of citizens have been introduced in the legislatures of four states. These, if rightly framed and properly administered, would have a eugenic value in cutting off defective streams of germ-plasm. They will be considered first.

The Nebraska bill (House No. 15) provides that the Board of Commissioners of State Institutions shall appoint two physicians to be known as the board of examiners of epileptics, feebleminded and other defectives. Their compensation shall be $10 a day while they are actually engaged in this work, and their duty shall be to examine into the physical and mental condition and record and family history of the feebleminded, epileptic and other defective inmates of the several State hospitals for the insane, State prisons, reformatories and charitable and penal institutions. If it shall be the judgment of this board that procreation by any such inmate "would produce children with an inherited tendency to crime, insanity, feeblemindedness, idiocy or imbecility and there is no probability that the condition of any such person so examined will improve to such an extent as to render procreation by any such person advisable, or if the physical or mental condition of any such person will be substantially improved thereby, then said board shall appoint one of its members to perform such operation for the prevention of procreation as shall be decided by said board to be most effective." Court procedure is made necessary, however, before the operation is actually carried out.

Section 4 of the bill provides that, "Except as authorized by this act, every person who shall perform, encourage, assist in or otherwise permit the performance of the operation for the purpose of destroying the power to procreate the human species or any person who shall knowingly permit such operation to be performed upon such person unless the same shall be a medical necessity, shall be guilty of a misdemeanor."

BILL ONCE VETOED

Those familiar with the recent history of restrictive eugenics will observe that this is almost identical with the bill which passed the Nebraska legislature two years ago. The only changes are that the former bill included criminals among the classes which might be sterilized, and made the offense in section 4 a felony instead of a misdemeanor, a penitentiary instead of a jail offense, so to speak. Governor John H. Morehead in vetoing the former bill on April 14, 1914, said: "This act is so far-reaching in its consequences and so intimately related to the social life of mankind, that legislative action should not be taken thoughtlessly or hurriedly. This proposed legislation is new and practically untried; at best it is only an experiment and it seems more in keeping with the pagan age than with the teachings of Christianity. Man is more than an animal." The governor further remarked that he thought the act might be unconstitutional, and pointed out, "There is no valid reason why this should be made to apply to wards of the State. These wards are under the care and control of superintendents appointed by the State, the different sexes are segregated and the danger sought to be obviated by this act is already well guarded against."

If the sexes are properly segregated in Nebraska institutions, and detained until they have passed the reproductive period, if not for life, then the writers agree with Governor Morehead's action in vetoing the bill, although they do not agree entirely with his reasons for doing so. The newly introduced measure applies only to the feebleminded, epileptic and defective wards of the State, omitting criminals as such. But Governor Morehead says these wards are already effectively segregated. The proposed sterilization measure therefore seems unnecessary, and should not be passed.

Several weaknesses in the measure might be pointed out; the writers will refer only to section 4, which would make it a misdemeanor for anyone to perform a sterilization operation, except on a ward of the State. In his veto message, the governor said, "I am heartily in favor of the provisions of section 4 of this act and would be pleased to sign a law making it a felony for any person to perform any operation for the purpose of destroying the power to procreate the human species and making it a felony for any person to permit such an operation to be performed." In the judgment of the writers, this attitude, which is unfortunately widespread, is a menace to eugenics. If the interests of society are best served when a man with given characteristics, in a state institution, is sterilized, then the interests of society will be served equally well when a man with the same characteristics, outside a State institution, is sterilized; and certainly no one will contend that all the cacogenic stock in the state of Nebraska, or any other State, is within the walls of the State institutions. It should be possible for any adult person in possession of his faculties to submit to the operation of sterilization if, in his judgment, it is to the interests of the race that he should not procreate. The Nebraska bill would legalize sterilization when it is for the physical well-being of the individual: is the physical well-being of the race less important than that of the individual? Cases constantly occur where high-minded persons seek sterilization in the interests of the race, knowing themselves to be carriers of defects or anti-social traits; it is to the interest of eugenics that such cases continue to occur. As for the low-minded persons who may seek sterilization to avoid the economic or social consequences of parenthood, it is certainly not to the interests of eugenics

that people of that character should leave offspring who are likely to resemble them.

From the standpoint of eugenics, therefore, we think it would be a mistake to pass a law which would make sterilization outside of State institutions absolutely impossible. No doubt the practice of it should be properly safeguarded, but that is a very different thing from branding it as a felony. It might be possible to have cases proposed for sterilization reviewed by a State board of experts, in order that quacks should not take advantage of freedom from restriction to work irreparable harm to credulous or cowardly young persons. Eugenists can be counted on, we believe to support any honest attempt of a State to find a means whereby sterilization can be properly controlled and directed, but we cannot countenance measures which will stigmatize eugenic asexualization as a crime.

WASHINGTON LEGISLATION

The State of Washington has had, since 1909, a law providing that courts may order the sterilization of habitual criminals and extreme sex-offenders. It is, as H. H. Laughlin, Superintendent of the Eugenics Record Office, says, "A purely optional and punitive statute that should be recast into an operable eugenical measure." An attempt was made to do this in 1913, but failed. Another bill was introduced in January of this year (House No. 24) providing that no person in any of the several Washington hospitals for the insane, or the State institution for the feebleminded, shall be discharged unsterilized if, in the judgment of the superintendent, procreation by such person "would produce children with an inherited tendency to crime, insanity, feeblemindedness, idiocy or imbecility, and there is no probability that the condition of such person will improve to such an extent as to render procreation by such person advisable." Friends or relatives of the patient may appeal from the decision of the superintendent to the Superior Court, who shall appoint three physicians to investigate. If a majority of this investigating committee overrules the superintendent's decision, the person shall be discharged from the institution. If they uphold the superintendent, "the court shall enter an order directing that such person shall not be discharged from such institution until such operation is performed." If the friends or relatives then consent to the operation, the patient shall be sterilized and discharged.

It is a temptation to State authorities, of course, to release as many of the State's wards as possible, in order to transfer the expense of their care from the State to private individuals. This is entirely proper if careful safeguards are established; but the present bill does not appear to us to provide any such safeguards. From a eugenic point of view, we think State segregation may give place to family segregation, where the relatives of an insane or feebleminded person are able to become responsible for him or her; but State segregation should not be replaced by sterilization and the reckless release of defective persons. The bulk of the persons affected will probably be the higher grades of feebleminded; these have the sexual impulses strongly developed, but their sexual inhibitions are weak or lacking: their freedom, sterilized, in the community, appears to us almost certain in a great many cases to make them foci for the dissemination of immorality and venereal diseases. That is a hygienic rather than a eugenic consideration, but it seems to us the most serious aspect of the sterilization idea. From the eugenic point of view, sterilization of the defective females would be most important, and it must not be forgotten that sterilization of females is a serious matter, leading to expense, illness, and frequently danger. It is not to be undertaken on a wholesale scale without careful consideration.

OBJECTION TO THE BILL

Our objection, then, to this bill is that it is not adequate to serve the purpose for which it is intended. It makes no provision for the proper segregation of defectives after they have been released from a State institu-

tion, apparently assuming that if they are sterilized the State has done its full duty. We consider this idea to be entirely erroneous. Defectives should not be released from State custody unless their relatives and friends are certain to care for them properly; and in such cases, sterilization will frequently—although doubtless not always—be unnecessary. We think this bill should be defeated. Washington's existing sterilization law is practically not in effect,[1] and if its legislators cannot improve on this attempt at amendment, the State had better get along without a sterilization law and keep its defective wards properly and permanently isolated.

MISSOURI LEGISLATION

Missouri makes its first attempt to enter the ranks of legislative eugenists, in House Bill No. 385, now pending, which, after declaring that "habitual criminals, moral degenerates and sexual perverts are menaces to public health, peace and safety," and defining those classes, requires all superintendents of State hospitals for insane and feebleminded and the superintendent of the State penitentiary to report quarterly to the State Board of Health the names, record, character and condition of any such persons in their care. The board of health shall investigate each case, and if the subject is found to be as described, he shall be sterilized. He or his friends or relatives may appeal to a circuit court; if the finding of the board of health is sustained, sterilization shall proceed.

This measure declares itself to be a police regulation rather than an attempt to improve the average value of heredity in the State. From a eugenic standpoint, it appears to the writers to be of little value, and its defeat is desirable. Eugenic and police or punitive measures should not be confused—if they are linked together the public will get an inaccurate idea of what eugenics means; nor is it desirable that eugenic sterilization be considered a form of punishment. Furthermore, the bill takes no account of whether the inmate of a hospital for the insane or feebleminded, or the State penitentiary, is going to remain there for life. If he is, sterilization is foolish—the sexes should be segregated. If he is not, more care should be made necessary in arranging for his future; he should not be dismissed in this offhand manner as a person of no further concern to the State. The framers of this measure give no evidence of understanding the purpose of sterilization from a eugenic point of view: they appear to look on it as a sort of patent medicine, a bottle of which will wholly cure one of these degenerates whom they have described as menaces to public health, peace and safety. The eugenist cannot share that view.

IOWA'S "EUGENIC LAW"

Iowa has taken the subject of "eugenic laws" very seriously, but without practical results to date. In 1911 it adopted a sweeping statute for sterilization, which was never actually put in effect,[2] in 1913 it repealed this and adopted a substitute law which is still theoretically in force but under which, so far as is known to us, no operation has ever been performed. It is optional as regards most classes of degenerates, compulsory in case of persons twice convicted of an ordinary felony or sexual offense, and compulsory after one conviction for "white slavery." The latter provision obviously lends itself well to the purposes of blackmailers who are already making such profitable use of the Mann White Slave Act. The Iowa statute has never commended itself to many people, and House Bill No. 365, now pending, proposes to repeal it, and substitute a new law omitting criminals as such from the act and making it apply only to insane, idiots, imbeciles and feebleminded, and the syphilitic, who are confined in State institutions. Sterilization is to be performed whenever the superintendent and a majority of his medical staff agree that it is for the best interests of any patient and society; vasectomy for men and salpingectomy for women

[1] Eugenics Record Office Bulletin 10B, p. 80.
[2] Ibid., p. 87.

are stipulated, a majority of the board of control must approve, and relatives or guardian of the patient must give their written consent. Obviously, this is a tremendous modification of the present law, and one in the right direction, although the inclusion of syphilitics in the classes which may be sterilized seems to the writers absolutely indefensible. Syphilis being a curable disease, there is no more reason for sterilizing a person with syphilis than a person with typhoid fever. The new bill also contains a provision that any person performing a sterilization operation except as provided for in this law shall be fined not more than $1,000 or imprisoned not more than one year in the penitentiary, or both. Were it not for this clause and the inclusion of syphilitics, the writers would favor the repeal of Iowa's present law and the adoption of this proposed measure; under the circumstances, it is hoped that this new proposal, unless amended will be defeated, and the old one repealed or allowed to rest in abeyance until a measure framed on more sensible lines can be introduced.

All things considered, the measures now pending in these four States do not indicate that the general public has been very well educated as to the possibilities and requirements of legislation to promote eugenics. A careful reading of the report of the Committee[3] which has been at work on the subject since 1911, under the chairmanship of Bleecker Van Wagenen, would show the proponents of these measures that they are in many cases far from the track marked out by genetics. And genetists are very strongly of the opinion that this is a subject on which they have the right to be heard.

"EUGENIC MARRIAGE LAWS"

But if legislative tendencies toward sterilization at the present time are of little value to the science of eugenics, certainly still less can be said for the widespread attempt to control marriage by various legislative devices. Bills which are hailed by the press and public as being "eugenic marriage laws" are now pending in the legislatures of nine States. In nearly every case these are wholly measures of social hygiene rather than eugenics; they are usually intended to aid in the campaign against venereal disease. The writers are in complete sympathy with this campaign, but not with its masquerade as a eugenic affair. The prevention of venereal disease is a matter of hygiene which lies in the field of public health; it has nothing whatever to do with eugenics, as venereal diseases are not hereditary and eugenics is concerned with heredity, not personal hygiene. The science of eugenics has plenty of work on its hands, without invading the field of preventive medicine, and it has already suffered enough in popular estimation through its undesired connection with sex hygiene. It is the duty of every eugenist vigorously to repudiate such bills as those which follow, in so far as they are represented to be eugenic laws; no matter how heartily he may indorse some or all of them as hygienic laws.

How far removed they are from the legitimate field of eugenics will best be seen by a review of them. Vermont has led the way with a bill passed by both houses of the legislature and approved by the governor on March 22, 1915, which provides a heavy fine or jail sentence for any person who, knowing himself to be infected with gonorrhea or syphilis, either marries or has sexual intercourse. Any physician treating a patient infected with a venereal disease must report the name, address, age and sex of such patient to the State Board of Health; he is paid $0.25 if he does and is fined $200 if he does not. The State Board of Health is empowered to make and enforce such rules and regulations for quarantining and treatment of venereal diseases as are deemed necessary. With the merits of this new law, the writers are not here concerned; they wish

[3] Report of the Committee to Study and to Report on the Best Practical Means of Cutting Off the Defective Germ-Plasm in the American Population. Eugenics Record Office, Cold Spring Harbor, New York, February, 1914. Bulletin 10A, The Scope of the Committee's Work; Bulletin 10B, The Legal, Legislative and Administrative Aspects of Sterilization; both by Harry H. Laughlin, secretary of the committee.

merely to point out that *it is not a eugenic law.*

House Bill No. 259, now pending before the Vermont legislature, has more claim to the attention of eugenists, as it is intended to bar marriage to the imbecile, insane and epileptic, as well as to any person who is or has been within five years an inmate of asylum or poor-house, unless it is shown that the cause of such condition has been removed and that the prospective groom is able to support a family. License is also to be refused if either applicant is afflicted with a transmissible disease; freedom from such disease to be certified by a practicing physician. In view of the adoption of the law mentioned in the previous paragraph,it is not likely that this one will get on the statute books.

SOUTH DAKOTA'S BILL

At the request of the Social Science Club of Aberdeen, S. D., the Legislature of South Dakota is now considering a bill (House No. 131) which would require every applicant for a marriage license to present a certificate of fitness signed by the superintendent of the County Board of Health, showing that no communicable disease or mental or physical defect exists against contracting the marriage relation. In order that he may certify to this fitness, the superintendent of the County Board of Health shall make a personal examination of each applicant, at a cost of $5 to the applicant; if he decides that a laboratory test is necessary, he shall so order and $10 more shall be collected from the applicant. No certificate of fitness to marry shall be issued to an insane, feebleminded, epileptic or syphilitic person unless he or she has previously been sterilized. Transmissible contagious disease is an absolute bar to marriage.

In regard to this and other bills of the same type, little comment need here be made. They are badly designed and should not be passed, as eugenic measures.

The legislature of the state of New York is now considering a bill (House No. 513) amending the present law regarding marriages in such a way as to prohibit the issuance of a marriage license unless the applicant presents a certificate from a physician "that such applicant is free from any physical or mental infirmity or disease which is likely to be contagious, communicable or hereditary." A consideration of the experience of Wisconsin and its notorious "eugenic law" ought to cool the ardor of the backers of this measure.

Indiana is similarly considering a measure (Senate Bill No. 16) requiring applicants for a marriage license to present a certificate from a reputable physician showing that they are not feebleminded, insane, or afflicted with an open case of tuberculosis or any transmissible disease. The introduction of this bill may at least have some educative value on public opinion, by calling attention to the fact that tuberculosis is an extremely undesirable thing in a prospective life partner.

A so-called Eugenics bill has also been introduced into the Senate of Illinois. It requires that health certificates, signed by physicians, shall be presented by the prospective bride and groom prior to the issuance of a marriage license, and that no county clerk shall issue a marriage license to any person suffering from a communicable disease. This is a public health law, not a eugenics law.

Missouri proposes to go back to the old system of banns, in House Bill No. 17, which requires each applicant for a marriage license to present a certificate from a reputable physician which shall state in concise terms the applicant's health and his fitness to marry. Notice of application for marriage license shall be published in a daily paper three consecutive times, at the expense of the county. If at the expiration of one day from the publication of the last notice, no charges have been filed with the recorder alleging applicant's unfitness to marry, license shall be granted. If objection be made by three persons not related in blood to each other, on the ground of any item mentioned in the physician's certificate, the case shall be taken before the circuit court; if the court sustains the objection of these three unrelated persons, a license to wed shall be denied; if the court overrules

the objection the license shall be granted and the objectors will have for their pains the feeling that they tried to do their duty—and also a bill for the court costs.

PUBLICATION OF BANNS

In so far as this measure has any bearing on eugenics it is, in the present state of public opinion, premature. The idea of publishing the banns has appealed to many eugenists as desirable in preventing hasty and ill-considered marriages. There is much to be said for it, but such a bill as this is not likely to commend itself to any genetist, as the proper method of procedure, because three unrelated laymen and the judge of a circuit court are not the proper persons to decide on the biological fitness of a proposed marriage. It should and probably will be defeated.

Oregon already has a law requiring the male applicant for a marriage license to present a health certificate. Two bills on this subject are now before the House; No. 273 would amend the law to make the woman present a similar certificate, while No. 161 would repeal the existing law altogether. The law has probably already done what little service to eugenics it can render, by calling public attention to the desirability of health in a marriage mate. At present, public opinion is the only thing that can operate effectively, and it will be no loss to eugenics if the existing Oregon law, which is *not* a eugenic law, is repealed.

Nebraska is considering the addition of medical duties to the other functions of the judiciary. House Bill No. 571, now pending, provides that no marriage license may be issued to a person infected with a venereal disease. To enable the county judge to decide this point, he may require both applicants to come before him so that he may question them, either under oath or not; he may also require them to give affidavits. He shall also require the *male* applicant to present the affidavit of a physician of good standing to the effect that said physician has made a careful and thorough examination of said male applicant and finds him free from all symptoms of infectious venereal disease. The physician shall be paid a fee of $5 by the applicant unless he thinks a laboratory test needed, when he shall insist on such a test being made and shall be entitled to a fee of $25 from the applicant.

Although often hailed as a "eugenic marriage law," this bill of course has nothing to do with eugenics. Since the point is frequently raised, however, it may be worth while to suggest that no test except a laboratory test is of any real value in determining whether or not a man or woman is infected with a venereal disease; and that $25 is a rather high fee for the Wasserman test with Noguchi control, or any other test which is to be a legal prerequisite to marriage and which is to have such a widespread application. The Nebraska bill is not well drawn and should die.

WISCONSIN'S EXPERIENCE

Wisconsin, which stepped to the front of the procession in 1913 by adopting a law, miscalled eugenic, requiring every applicant for a marriage license to present a health certificate, has been having trouble with the enforcement of that law ever since, and House Bill No. 197, introduced at the present session of the legislature, would repeal it. House Bill No. 100, also pending, would abolish the physician's certificate and merely require each applicant to state on honor that he or she is free from "any acquired venereal disease." The framer of this measure will immortalize himself among students of heredity if he can show us any venereal disease that is not acquired.

Such, in outline, are the so-called "eugenic laws" of the present season, known to us, that are being considered or have been considered by State Legislatures. Not one of them commends itself to us. Most of them have nothing to do with eugenics; those that have some connection with eugenics are so inadequate or so carelessly drawn that their passage is undesirable. Their presentation has a certain value, in arousing public sentiment to the need of restricting the production of defectives in this country; but their appear-

ance in the present form indicates that public sentiment still has a wrong idea of the proper and profitable relation that can and should exist between legislation and eugenics. In general the writers believe, and most genetists have come to the same view, that sterilization by law is not in many cases a desirable procedure for eugenists to advocate; that permanent isolation of the defective classes is a preferable means of dealing with them; and that neither the science of eugenics nor public sentiment is ready for legislation putting restrictions on marriage, so far as those restrictions are strictly eugenic rather than hygienic in intent.

The kind of legislation that will really advance the science of eugenics at the present time is legislation that provides for research. The public seems to have an idea that the study of heredity is being profoundly cultivated by many well-equipped institutions and a large body of workers. As a fact, the active workers in this field are, and always have been, merely a corporal's guard. Their achievement is far out of proportion to their fewness; yet they have done little more than scratch the surface of the field. We have learned much; we have enough knowledge to make definite action profitable in many lines; but the distance we have yet to go is far greater than that we have already traversed. Immediate action in negative eugenics is in many quarters desirable, but the great need of eugenics, and one that is not being adequately met, is the need for more facts.

It is time for the friends of eugenics to stop promoting such legislation as that herein outlined, and to divert more of their energy to a broad, constructive policy for the furtherance of eugenics. They may, for example, very profitably help to:

Promote research in heredity;

Disseminate a knowledge of the laws of heredity;

Create a "eugenic conscience" in the public;

Give the young people of their acquaintance a chance to meet and fall in love with suitable life-partners;

Further every means that will remove some of the social and economic bars to marriage and parenthood, that now tell so heavily on our eugenically superior classes.

Heredity In Apples

Apple breeding was begun at the New York state experiment station (Geneva, N. Y.) in 1898, and 148 seedlings of crosses then made have fruited. The results of these crosses have satisfied the experimenters: (i) that seedling apples have very little tendency to revert to the wild prototype, despite the popular belief to the contrary; (ii) that some of the characters of apples seem to be prepotent in transmission. The vigor expected of a first hybrid generation is found to a marked degree.

Interesting facts regarding the inheritance of separate traits have been worked out. In color of skin, the fruits in which yellow predominates over red seem to be heterozygous; the fruits in which red predominates seem to be either homozygous or heterozygous, while those of pure yellow color are apparently homozygous. As to color of flesh in Ben Davis and McIntosh, whose crosses were most carefully studied, there is reason to believe that they carry both yellow and white, the latter being recessive. Sourness and sweetness may be allelomorphs, the former a dominant and the latter a recessive, since in many crosses there were three sour apples for every sweet one. In general, the experimenters do not think Mendelism offers much practical promise in improving varieties of apples. They further think that size and shape are inherited in an intermediate or blended condition: which is perhaps the same as saying that they are caused by so many separate characters, inherited independently, that the crosses produce almost every possible result.

NATURE OR NURTURE?

Actual Improvement of the Race Impossible Except through Heredity—Facts on Which the Eugenist Bases His Faith—The Attitude of Eugenics Toward Social Problems[1]

THE EDITOR

LITTLE more than a year ago I sat on the same platform with the late Jacob Riis, at a conference on race betterment. A number of members of our association spoke of the need for improving the heredity of the children of the slums. Finally Jacob Riis took the floor.

"We have heard friends here talk about heredity," he exclaimed. "The word has rung in my ears until I am sick of it. Heredity, heredity! There is just one heredity in all the world that is ours—we are children of God, and there is nothing in the whole big world that we cannot do in his service with it."

That, I regret to say, is the attitude still held by a great many social workers—the people who would see the power of heredity demonstrated before their own eyes every day, if their eyes were not closed by preconceived ideas. I am not going to waste any time demonstrating to you that there is such a thing as heredity, because I believe you would all be willing to admit it—as an academic question, as a theory. But I dare say that when it comes to practice, a great many of you tacitly proceed on the assumption that Jacob Riis stated so explicitly and vigorously. You want to see the world made better, and you therefore support charities, legislation, uplift movements, philanthropic attempts at social betterment, all of which have as their object the improvement of the environment of persons who are living in a bad environment. You believe that by so doing you ensure the improvement of the race.

Now if you are right in acting on this principle, then we eugenists are largely wrong. If you can better the race by improving its environment, then you have found a short cut in social progress, which we are too blind or stupid to follow. If all that every man needs is a chance, then we are hunting on the wrong scent.

The faith of the social worker, the legislator, the physician, the sanitarian, in his method of improving the race is very literally the kind of faith that St. Paul described as the substance of things hoped for, the evidence of things not seen. We eugenists have a stronger faith, because it is based on things that are seen, and that can even be measured. We think we can prove that it is, on the whole, man who makes the environment, not the environment which makes man. We are far from denying that nurture has an influence on nature, to use Galton's antithesis, but we believe that the influence of nurture, the environment, is only a fifth or perhaps a tenth that of nature—heredity.

If we can prove this to you, I think eugenics will have justified its claim to consideration. If we cannot you may properly scorn us for wasting your time and ours. I shall therefore give up this evening to an endeavor to prove to you that man is largely the product of his heredity, and that environment has no power to improve this heredity and not much, within ordinary limits, to deteriorate it. If I succeed in convincing you, I shall expect you to join us in believing that the way to improve the race is not to work on a lot of bad heredity, but to see that a larger supply of good heredity is made available.

WHAT BIOLOGY TEACHES

The problem, like many others in eugenics, might be attacked from two

[1] A lecture to the Young Men's Christian Association, Washington, D. C., March 18, 1915.

sides—the biological and the statistical. An understanding of the facts of biology leads us to expect that heredity should be nearly all-powerful and the force of environment slight. Experiments confirm this expectation. The University of Missouri, for example, is now carrying on a long breeding experiment to determine whether the milking capacity of cows is due to heredity, or whether it is largely dependent on the good care and feed they receive. Cows are being subjected to all sorts of treatment at all ages, and the experiment has shown beyond question that the milk-yield is a matter of heredity, and is very little influenced by differences in the treatment of cows at any age. In plants and low animal organisms the influence of the environment is considerable, but it diminishes as we rise higher in the evolutionary scale. The student of modern biology can hardly conceive of the possibility that heredity in man should not be more important than environment.

But that would not be a convincing way of presenting the problem to this audience, and I shall therefore present it largely from the statistical side. When we deal with things that we can measure and express in numbers, we have facts whose value you can decide for yourselves. I shall not try to present a solution of the problem in general terms, for I do not think it can be done, but I shall pick out a number of definite examples and try to show you the relative weight of heredity and environment in them.

At the Race Betterment Conference, of which I spoke at the beginning of this paper, Byron W. Holt, a prominent New York social worker, declared, "It will hardly be denied that the two most important and fundamental causes of preventable disease, as well as of crime and race deterioration, are (1) ignorance and (2) poverty." It certainly will be denied; I venture to say that it will be denied, and vehemently denied, by anyone who knows anything about the facts. Such a confusion of cause and effect is the most widespread and serious hindrance to the spread of eugenic ideas. Because a good environment makes it possible for hereditary traits to get expression, people jump to the conclusion that the environment created these traits. The improvement of the environment, absolutely essential as it is, must never be neglected for a minute; but our mistake has been in looking on it as an end rather than as a means. It is not an end; it is merely a means of giving good heredity a chance for expression. If the good heredity is not there, it is hardly worth while to improve the environment: certainly it is a waste of time if it is done with the idea of thereby improving a stream of bad heredity in it.

SOME FAMILIAR EXAMPLES

The limited effect of nurture in changing nature is in some fields a matter of common observation, if you only stop to think of it in that light. You men who work in the gymnasium know that exercise increases the strength of a given group of muscles, but that this does not go on increasing indefinitely. There comes a time when the limit of your hereditary potentiality is reached, and no amount of exercise will gain another millimeter in the circumference of your arm. Similarly the handball or tennis player some day reaches his highest point, and even if he redoubles his amount of practice and study of the game after that, he is unable to increase the precision of his shots or the speed of his play. The same thing applies to runners or race horses—one can do no more than give their inborn ability a chance to express itself. A trainer could bring Arthur Duffy in a few years to the point of running a hundred yards in $9^{3}/_{5}$ seconds, but no amount of training after that could clip off another fifth of a second; while if the same trainer had had me, even from childhood, it is doubtful whether he would ever have gotten me to run it in 10 seconds. A parallel case is found in the students who take a college examination. Half a dozen of them may have devoted the same amount of time to it—may have crammed to the limit—but they will still receive widely different marks. These commonplace cases show that nurture has seemingly

some power to mould the individual, by giving his inborn possibilities a chance to express themselves, but that nature says the first and last word. Francis Galton, the father of eugenics, hit on an ingenious and more convincing illustration, by studying the history of twins.

There are, as you know, two kinds of twins—ordinary twins and the so-called identical twins. Ordinary twins are merely brothers, or sisters, or brother and sister, who happen to be born two at a time, because two ova have developed simultaneously. The fact that they were born at the same time does not make them alike—they differ quite as widely from each other as ordinary brothers and sisters do. Identical twins have their origin in a different phenomenon—they are halves of the same egg, which split in two at a very early stage of its development, each of the halves then developing into a separate individual. As would be expected, these identical twins are always of the same sex, and extremely like each other, so that sometimes their own mother can not tell them apart. This likeness extends to all sorts of traits—they may lose their milk teeth on the same day, they may become sick on the same day with the same disease, even though they be in different cities, and so on.

Now Galton reasoned that if environment really changes the inborn character, then these identical twins, who start life as halves of the same whole, ought to become more unlike if they were brought up apart; and as they grew older and moved into different spheres of activity, they ought to become measurably dissimilar. In the case of ordinary twins, who start dissimilar, they ought to become more alike when brought up in the same family, on the same diet, among the same friends, with the same education. If the course of years shows that identical twins remain as like as ever and ordinary twins as unlike as ever, regardless of changes in conditions, then environment will have failed to demonstrate that it has any great power to modify one's inborn nature.

With this view, Galton collected the history of eighty pairs of identical twins, thirty-five of which cases were accompanied by very full details, which showed satisfactorily that the twins were really as nearly identical, in childhood, as one could expect to find. I can not quote his long and interesting descriptions of them; I can only state the conclusion. In the case of these thirty-five pairs who were "closely alike" in both body and mind, during childhood and youth, when they were brought up in the same environment, what changes did their separation into different environments, different walks of life, when they grew up, produce? In many cases the resemblance of body and mind continued unaltered up to old age, notwithstanding very different conditions of life; in others a severe disease was sufficient to account for some change noticed. Other dissimilarity that developed, Galton had reason to believe, was due to the development of inborn characters that appeared late in life. He therefore felt justified in broadly concluding "that the only circumstance, within the range of those by which persons of similar conditions of life are affected, that is capable of producing a marked effect on the character of adults, is illness or some accident which causes physical infirmity. The twins who closely resembled each other in childhood and early youth, and were reared under not very dissimilar conditions, either grow unlike through the development of natural (that is, inherited) characteristics which had lain dormant at first, or else they continue their lives, keeping time like two watches, hardly to be thrown out of accord except by some physical jar."

Now let us consider the ordinary twins, who were unlike from the start, and see how far nurture has made them resemble each other. I cannot take time to cite Galton's evidence, which was presented in his usual cautious way. It led him to write: "The impression that all this evidence makes on the mind is one of some wonder whether nurture can do anything at all, beyond giving instruction and professional training." The unlike twins never became any more like, no matter

under how similar conditions they existed; so that to Galton there seemed "no escape from the conclusion that nature prevails enormously over nurture, when the differences of nurture do not exceed what is commonly to be found among persons of the same rank in society and in the same country."

This kind of evidence was a good start for eugenics, but as the science grew, we outgrew such evidence. We no longer wanted to be told, no matter how minute the details, that "nature prevails enormously over nurture." We wanted to know exactly how much. We refused to be satisfied with the statement that a certain quantity was large; we demanded that it be measured or weighed. So Galton, Karl Pearson and other mathematicians devised means of doing this, and then Professor Edward L. Thorndike of Columbia University took up Galton's problem again, with the new methods, from whose conclusions we think there can be no appeal.

THE COEFFICIENT OF CORRELATION

The tool used by Professor Thorndike was the coefficient of correlation, which shows the amount of resemblance or association between any two things that are capable of measurement, and is expressed in the form of a decimal fraction somewhere between 0 and the unit 1. Zero shows that there is no constant resemblance at all between the two things concerned, that they are wholly independent of each other, while 1 shows that they are completely dependent on each other—a condition that rarely exists, of course.[2] For instance, the correlation between the right and left femur in man's legs is .98. The nearer our fraction approaches unity, the greater is the resemblance and the smaller it is, the less is the resemblance; while a coefficient of .9 is, of course, three times as great as a coefficient of .3; and so on.

Thorndike picked out in the New York schools fifty pairs of twins about the same age and measured the closeness of their resemblance in eight physical characters, and also in six mental characters, the latter being measured by the proficiency with which the subjects performed various tests. Then children of the same age and sex, picked at random from the same schools, were measured in the same way. It was thus possible to tell how much more alike twins were than ordinary children in the same environment.

"If now these resemblances are due to the fact that the two members of any twin pair are treated alike at home, have the same parental models, attend the same school and are subject in general to closely similar environmental conditions, then (1) twins should, up to the age of leaving home, grow more and more alike, and in our measurements the twins 13 and 14 years old should be much more alike than those 9 and 10 years old. Again (2) if similarity in training is the cause of similarity in mental traits, ordinary fraternal pairs not over four or five years apart in age should show a resemblance somewhat nearly as great as twin pairs, for the home and school condition of a pair of the former will not be much less similar than those of a pair of the latter. Again, (3) if training is the cause, twins should show greater resemblance in the case of traits much subject to training, such as ability in addition or in multiplication, than in traits less subject to training, such as quickness in marking off the A's on a sheet of printed capitals, or in writing the opposites of words."

THORNDIKE'S CONCLUSIONS

The data were elaborately analyzed from many points of view. They showed (1) that the twins 12-14 years old were not any more alike than the twins 9-11 years old, although they ought to have been, if environment had any power to mould the character during these so-called "plastic years of childhood." They showed (2) that the resemblance between twins was two or

[2] What I say here refers to positive correlations, which are the only kind I cite in this paper. Correlations may also be negative, lying between 0 and —1: for instance, if we measured the correlation between a man's lack of appetite and the time that had elapsed since his last meal, we should have to express it by a negative fraction, the minus sign showing that the greater his satiety, the less would be the time since his repast.

three times as great as between ordinary children of the same age and sex, brought up under similar environment. There seems to be no reason why twins should be more alike, unless it is due to the power of heredity. The data showed (3) that the twins were no more alike in traits subject to much training than in traits subject to little or no training. Their achievement in these traits was determined by their heredity; no amount of training could alter these hereditary potentialities.

"The facts," Thorndike wrote, "are easily, simply and completely explained by one simple hypothesis: namely, that the natures of the germ-cells—the conditions of conception—cause whatever similarities and differences exist in the original natures of men, that these conditions influence mind and body equally, and that in life the differences in modification of mind and body produced by such differences as obtain between the environments of present-day New York City public school children are slight." He reached the same conclusion that other studies of this sort have shown, that in the make-up of the individual there are probably nine parts of heredity for every one of nurture or training.

"The inferences," he says, "with respect to the enormous importance of original nature in determining the behavior and achievments of any man in comparison with his fellows of the same period of civilization and conditions of life are obvious. All theories of human life must accept as a first principle the fact that human beings at birth differ enormously in mental capacities and that these differences are largely due to similar differences in their ancestry. All attempts to change human nature must accept as their most important condition the limits set by original nature to each individual."

Meantime other investigators, principally followers of Karl Pearson in England, were working out correlation coefficients in other lines of research for hundreds of different traits. It was found, no matter what physical or mental trait was measured, that the coefficient of correlation between parent and child was a little less than .5 and that the coefficient between brother and brother, or sister and sister, or brother and sister, was little more than .5. On the average of many cases, the mean "nature" value, the coefficient of direct heredity, was placed at .51. This gave another means of measuring the relative importance of nature and nurture, for it was also possible to measure the relation between any trait in the child and some factor in the environment. A specific instance will make this clearer.

MYOPIA OF SCHOOL CHILDREN

We know that school children show an appalling amount of eye trouble, particularly short-sightedness. Now suppose it is suggested that this is because they are allowed to learn to read at too early an age. We can find out the age at which any given child did learn to read, and work out the coefficient of correlation between this age and the child's amount of myopia. If we find the relation is very close between them—say .7 or .8—we will know that the earlier a child learns to read, the more short-sighted he is as he grows older. This will not prove a relation of cause and effect, but it will at least give us great suspicion. If on the contrary we find the correlation very slight, we are forced to admit that early reading has nothing to do with the prevalence of defective vision among school children. If we similarly work out all the other correlations that can be suggested, finding whether there is any regular relation between myopia and overcrowding, long hours of study, general economic conditions at home, general physical or moral conditions of parents, the time the child spends out of doors, etc., and if we find there is no relation of any moment between these various factors and myopia, we are driven to admit that no factor of the environment which we can think of as likely to cause the trouble really has anything to do with the poor eyesight of our school children. This has actually been done, and none of the conditions I have enumerated has been found to be closely related to myopia

in school children. Correlations between fifteen environmental conditions and the goodness of children's eyesight were measured, and only in one case was the correlation as high as .1. The mean of these correlations was about .04—an absolutely negligible quantity when compared with the heredity coefficient of .51. Does this prove that the myopia is rather due to heredity? It would, by a process of exclusion, if we could be sure that we had measured every conceivable environmental factor and found it wanting. We can never reach that point in the investigation, but we have at least reached, it seems to me, a tremendously strong suspicion. Now if we go on and measure the degree of resemblance between the prevalence of myopia in parents and that in children, and if we find that when the parent has eye trouble, the child also has it, then it seems to me that our general knowledge of heredity should lead us to believe that we have put our finger on the difficulty, and that we were seeking an environmental cause for the poor vision of the school child, when it was all the time due almost entirely to heredity. This final step has not yet been completed in an adequate way,[3] but the evidence we have, partly analogical, gives every reason to believe in the soundness of the conclusion I stated, that in most cases the school-boy must wear glasses because of his heredity, not because of overstudy or any neglect on the part of his parents to care for his eyes properly during his childhood.

I have explained this case at some length, so you might understand clearly the way in which we have proceeded to pile up mathematical proof of the preponderating importance of heredity as compared with environment. I shall now run over several similar cases more hastily.

INTELLIGENCE OF SCHOOL CHILDREN

The extent to which the intelligence of school children is dependent on defective physique and unfavorable home environment is an important practical question, which David Heron of London attacked by the methods I have outlined. He wanted to find out whether the healthy children were the most intelligent. We are constantly hearing stories of how the intelligence of school children has been improved by some treatment which improved their general health, but these stories are rarely presented in such a way as to constitute evidence of scientific value. We wanted to know what exact measurement would show: whether it was really possible that the dullards became prodigies as soon as their adenoids were removed, whether hot lunches really increased the brain power, and so on. The intelligence of all the children in fourteen schools was measured in its correlation with weight and height, condition of clothing and teeth, state of nutrition, cleanliness, good hearing, and the condition of the cervical glands, tonsils and adenoids. It could not be found that mental capacity was closely related to any of the characters dealt with. The rather curious set of characters measured was taken because it happened to be furnished by data collected for another purpose; the various items are suggestive rather than directly conclusive. Here again, the correlation in most cases was less than .1, as compared with the heredity correlation of .5.

Next, take the very complex subject of tuberculosis. Certainly we would not say that it is inherited, but there is

[3] Dr. James Alexander Wilson, assistant surgeon of the Opthalmic Institute, Glasgow, published an analysis of 1,500 cases of myopia in the *British Medical Journal*, p. 395, August 29, 1914. His methods are not above criticism, and too much importance should not be attached to his results, which show that in 58% of the cases heredity can be credited with the myopia of the patient. In 12% of the cases it was due to inflammation of the cornea (keratitis) while in the remaining 30% no hereditary influence could be proved, but various reasons made him feel certain that in many cases it existed. The distribution of myopia by trades and professions among his patients is suggestive: 65% of the cases among school children showed myopic heredity, 63% among housewives and domestic servants, 68% among shop and factory workers, 60% among clerks and typists, 60% among laborers and miners. If environment really played an active part, one would not expect to find this similarity in percentages between laborers and clerks, between housewives and school children, etc.

good reason to believe that its appearance in any individual is largely due to his inheritance of what physicians call the tubercular diathesis—that is, a weakness of the constitution predisposing to tuberculosis. As compared with this factor, all factors of infection are of relatively small importance. Under modern city conditions, it is almost certain that one who leads a moderately active life will be exposed to infection from tuberculosis every day. Whether he succumbs or resists will depend on his heredity.

But, it is argued, at any rate bad housing and unsanitary conditions of life will make infection more easy and lower the resistance of the individual. Perhaps such conditions may make infection more easy, but that is of little importance considering how easy they are for each of us—for the population as a whole. The question remains, will not bad housing cause a greater liability to fatal phthisis? Will not destitution and its attendant conditions increase the probability that a given individual will succumb to the white plague?

CAUSES OF DEATH FROM PHTHISIS

Most physicians think this to be the case, but they have not taken the pains to find out, by the exact methods of modern science. We are accustomed to take their word on the subject, because we think they ought to know. Dr. Knopf of New York, one of the country's authorities on tuberculosis, recognizes the importance of the heredity factor, but says that after this, the most important predisposing conditions are of the nature of unsanitary schools, unsanitary tenements, unsanitary factories and workshops. This may be very true; these conditions may follow after heredity in importance—but how near do they follow? That is a matter that is capable of fairly accurate measurement, and we ought to have figures, not generalities.

Taking the case of destitution, which includes, necessarily, most of the other evils specified, Pearson measured the correlation with liability to phthisis and found it to be .02. The correlation for tuberculosis between parent and child, on the other hand, was found from several investigations to be about .50—just what we should expect, for that is the correlation in general for physical and mental characters in heredity. It is also the correlation for the inheritance of such pathological characters as insanity and congenital deafness, where certainly infection of child by parent could not be suspected.

Nevertheless, many thought that the high correlation between parent and child, in the case of tuberculosis, must be due to infection. The family relations are so intimate, they said, that it is folly to overlook this factor in the spread of the disease.

Very well, Pearson replied, if the relations between parent and child are so intimate that they lead to infection, they are certainly not less intimate between husband and wife, and there ought to be just as much infection in this relationship as in the former. The correlation was measured in thousands of cases and was found to lie around .25, being lowest in the poorer classes and highest in the well-to-do classes.

At first glance this looks like a damaging correlation—it looks as if there must be a considerable amount of tubercular infection between husband and wife. But when we find that the resemblance between husband and wife in the matter of insanity is also .25, we must pause. Certainly it will hardly be argued that one of the partners infects the other with this disability!

ASSORTATIVE MATING

As a fact, this correlation of say .25 between husband and wife, for tuberculosis, probably means very little for infection. What it does mean is that like tends to mate with like—in the more prosperous classes, at least, where there is a considerable range of choice. It means assortative marriage, sexual selection. This coefficient of resemblance between husband and wife in regard to phthisis is about the same as the correlation of resemblance between husband and wife for eye color, stature, longevity, general health, truthfulness, tone of voice, and many other charac-

ters. No one will suppose that life partners "infect" each other in these respects. Certainly no one will claim that a man deliberately selects a wife on the basis of a resemblance to himself in these points; but he most certainly does so unconsciously—a fact not discovered until the application of exact methods to the study of heredity revealed it and destroyed the old popular belief that unlike persons tend to marry each other. Assortative mating is now a well-established fact, and there is reason to believe that much, if not most, of the resemblance between husband and wife as regards tuberculosis is due to this fact, and not to infection. The comparison between heredity and environment which I made above is, therefore, a perfectly legitimate one—that is, .02 between environment and phthisis in the child, .50 between a tuberculous parent and the same disease in the child.

We would not dogmatically assert that right environment is of no importance in the case of tuberculosis; but our knowledge justifies us in asserting that no feature of the environment is as important as the heredity; and that the effective way to stamp out the White Plague is not to be found in the multiplication of sanatoria and restrictive regulations, or even in the better sanitation of our slums, desirable as these things may be in themselves; but that tuberculosis will be most surely and quickly eradicated when marriages between persons who come from tuberculous stocks are prevented.

EMPLOYMENT OF MOTHERS

Now take the question of employment for mothers. There has been a deal of agitation on the subject in recent years, and a certain amount of legislation has been passed, particularly in France, to relieve mothers of work outside their own homes. This is a desirable object in many ways, but if it is claimed, as it usually is claimed, that employment of mothers is detrimental to their children, and that mothers who stay at home and give all their time to their children will bring up healthier and more intelligent children, the assumption is involved that the character of the child is due to his environment as well as to his heredity; and the eugenist properly may demand the right to be heard. It is possible to measure with fair accuracy the correlation between employment of mother and various characters such as weight, height, health and intelligence of her children. This has been done with some carefully compiled Scotch statistics, and it has been found that the correlations are almost insignificant, averaging .11. To put the conclusion in less mathematical language, the fact that a mother may be employed outside her own home is found not to have any noteworthy unfavorable result on such characters of the children as were measured—namely, height, weight, general health and general intelligence. On the basis of these figures, the eugenist demands that the movement for changes in our present social arrangements, such as will permit mothers to stay at home and give all their time to their children, appear in the proper light, and that it do not claim to be able to improve the character of the children, when that character is really determined at birth and can be little influenced afterward by any except extraordinary environmental conditions.

These problems of bad breeding are pressing problems, but I have discussed them long enough. After all, eugenics, as its name indicates, is more interested in good breeding than in bad breeding. Let us see how heredity and environment are related in the production of great mental and moral superiority. If we can learn that, we ought to be in the way of producing more such superiority in the world—a thing as to the desirability of which there need be no argument.

If success in life—the kind of success that is due to great mental and moral superiority—is due to the opportunities a man has, then it ought to be pretty evenly distributed among all the persons who have had favorable opportunities, provided we take a big enough number of persons to allow the laws of probability full play. England offers a good field to investigate this point, because Oxford

and Cambridge, her two great universities, turn out practically all the eminent men of the country, or at least have done so until recently. If nothing more is necessary to ensure a youth's success than to give him a first-class education and the chance to associate with superior people, then the prizes of life ought to be pretty evenly distributed among the graduates of the two universities, during a period of a century or two.

SUCCESS A FAMILY AFFAIR

This is not the case. When we look at the history of England, as Galton did nearly half a century ago, we find success in life is pretty strictly a family affair. The distinguished father is likely to have a distinguished son, while the son of a nobody has a very small chance of becoming distinguished. To cite one concrete case, Galton found that the son of a distinguished judge had about one chance in four of becoming himself distinguished, while the son of a man picked out at random from the population had about one chance in 4,000 of becoming similarly distinguished.

The objection at once occurs that perhaps social opportunities yet play the predominant part; that the son of an obscure man never gets a chance, while the son of the prominent man is pushed forward regardless of his inherent abilities. This, as Galton showed at length, can not be held to be true of men of really eminent attainments. The true genius rises despite all obstacles, while no amount of family pull will succeed in making a mediocrity into a genius, although it may land him in some high and very comfortable official position. Galton found a good illustration in the papacy, where during many centuries it was the custom for a pope to adopt one of his nephews as a son, and push him forward in every way. If opportunity were all that is required, these adopted sons ought to have reached eminence as often as a real son would have done; but statistics show that they reached eminence only as often as would be expected for nephews of great men, whose chance is notably less, of course, than that of sons of great men, in whom the force of heredity is much stronger.

But we can come closer home and present a telling argument, I believe, from this, our own land of equal opportunities, where it is a popular superstition that every boy has a chance to be president, and where the youth reared in the log cabin and educated in the little red school-house is the dark horse we usually pick as a winner. The picturesque environment of some of our great men has so interested us that we have almost come to believe it is this environment—the log cabin and country school-house, for example—that have made these men great. A more careful scrutiny of the facts may convince us that such environment was nothing more than an incident, sometimes beneficial, sometimes prejudicial. It was their sterling heredity which carried these boys to the top. Let us look at the records of the eminent men this country has produced, in order to see whether in free America the prizes of life are in the grasp of all. Success may be a family affair in caste-ridden England; is it possible that such could be the case in our own continent of boundless opportunities?

Galton found that about half of the great men of England had distinguished close relatives. Now if our great men of America have fewer distinguished close relatives, environment will be able to make out a plausible case, and we will have to accredit some of the success of England's great men to family pull, rather than family heredity.

AMERICA'S GREAT MEN

Dr. F. A. Woods, chairman of the eugenics research committee of the American Genetic Association, has worked out this problem, and his results are a very satisfactory vindication of our claims.

First, let us find how many eminent men there are in our history. Biographical dictionaries list about 3,500 and it will be convenient to take this number, since it provides an unbiased standard from which to work. Now, Woods says, if we suppose the average

person to have as many as twenty close relatives—as near as an uncle or a grandson—then computation shows that only one person in 500 in the United States has a chance to be a near relative of one of our 3,500 eminent men—provided it is purely a matter of chance. As a fact, the 3,500 eminent men listed by the biographical dictionaries are related to each other not as one in 500, but as one in five. If the more celebrated men alone be considered, it is found that the percentage increases so that about one in three of them has a close relative who is also distinguished. "This ratio increases to more than one in two when the families of the forty-six Americans in the Hall of Fame are made the basis of study. If all the eminent relations of those in the Hall of Fame are counted, they average more than one apiece. Therefore, they are from five hundred to a thousand times as much related to distinguished people as the ordinary mortal is."

To look at it from another viewpoint, something like 1% of the population of the country is as likely to produce a man of genius as is all the rest of the population put together—the other 99%. And this is due not to environment, but to biological heredity. Let me prove this to you by running rapidly over Dr. Woods' careful studies of the royal families of Europe. Here certainly we may say that—on the whole, at least—environment has always been favorable. It has varied, naturally, in each case, but speaking broadly it is certain that all the members of this group have had the advantage of a good education, of all the care and attention that could possibly be given. If environment affects achievement, then we ought to expect the achievements of this class to be pretty generally distributed among the whole class. If opportunity is the cause of a man's success, then we ought to expect most of the members of this class to have succeeded, because to every one of the royal blood the door of opportunity usually stands open. We would expect the heir to the throne to show a better record than his younger brothers, however, because his opportunity to distinguish himself is naturally greater. I shall discuss this last point first.

EMINENCE IN ROYALTY

Dr. Woods divided all the individuals in his study into ten classes for intellectuality and ten for morality, those most deficient in these qualities being put in class 1, while the men and women of preeminent intellectual and moral worth were put in class 10. Now if preeminent intellect and morality were at all linked with the better chances that an inheritor of succession has, then we ought to find heirs to the throne more plentiful in the higher grades than in the lower. Actual count shows this not to be the case. A slightly larger percentage of inheritors is rather to be found in the lower grades. The younger sons have made just as good a showing as the ones who succeeded to power: as we should expect if intellect and morality are due largely to heredity, but as we should not expect if intellect and morality are due largely to outward circumstances.

Are "conditions of turmoil, stress and adversity" strong forces in the production of great men, as has often been claimed? There is no evidence from facts to support that view. In the case of a few great commanders, the times have seemed particularly favorable. Napoleon, for example, could hardly have been Napoleon had it not been for the French revolution. But in general there have been wars going on during the whole period of modern European history; there have always been opportunities for a royal hero to make his appearance; but often the country has called for many years in vain. Circumstances were powerless to produce a great man and the nation had to wait until heredity produced him. Spain has for several centuries been calling for genius in leadership; but in vain. England could not get an able man from the Stuart line, despite her need, and had to wait for William of Orange, who was a descendant of a man of genius, William the Silent. "Italy had to wait fifty years in bondage for her deliverers, Cavour, Garibaldi and Victor Emmanuel."

"The upshot of it all," Woods decides, "is that, as regards intellectual life, environment is a totally inadequate explanation. If it explains certain characters in certain instances, it always fails to explain many more; while heredity not only explains all (or at least 90 % of the intellectual side of character in practically every instance, but does so best when questions of environment are left out of discussion."

GENIUSES CLOSELY RELATED

Despite the good environment almost uniformly present, the geniuses in royalty are not scattered over the surface of the pedigree chart, but form isolated little groups of closely related individuals. One centers in Frederick the Great, another in Queen Isabella of Spain, a third in William the Silent, and a fourth in Gustavus Adolphus. Furthermore, the royal personages who are conspicuously low in intellect and morality are similarly grouped. Careful study of the circumstances shows nothing in the environment that would produce this grouping of genius, while it is exactly what our knowledge of heredity leads us to expect.

In the next place, do the superior members of royalty have proportionately more superior individuals among their close relatives, as we found to be the case among the Americans in the Hall of Fame? A count shows at once that they do. The first six grades all have about an equal number of eminent relatives, but grade 7 has more, while grade 8 has more than grade 7, grade 9 has more than grade 8, and the geniuses of grade 10 have the highest proportion of near relatives of their own character. Surely it cannot be supposed that a relative of a king in grade 8 has on the average a much less favorable environment than a relative of a king in grade 10. Is it not fair, then, to assume that this relative's greater endowment in the latter case is due to heredity?

Conditions are the same, whether males or females be considered.

Woods next strengthens his case by mathematics, working out coefficients of correlation for the characters of his subjects. I shall not trouble you with these, but shall merely tell you that on the whole they correspond with surprising closeness to the figures which theory would lead us to expect.

Thus, the reasons for the belief that heredity is almost the entire cause for the mental differences of these men and women, and that environment or free-will must consequently play very minor roles, are that the measurements we make of actual cases coincide almost exactly with what the laws of heredity lead us to expect; and secondly, the fact that environment or opportunity can hardly be expected to cause, in royalty at least, the great names to occur in close blood connection with others of the same stamp, as we find that they do occur.

It will be interesting to see just what Woods thinks the proportion of real genius in royalty is. His study includes 823 individuals about whom he was able to get sufficiently detailed data to work on, and in this number about twenty are to be classed as geniuses—men who would have made their mark as geniuses by their worth alone, starting from any walk of life, and quite apart from the favorable opportunities which their royal blood furnished them. This score of geniuses includes Louis II of Bourbon, "The Great Condé;" William the Silent, of Orange; John the Great of Portugal; Frederick William, the Great Elector of Prussia; Frederick the Great; Gustavus Vasa and Gustavus Adolphus of Sweden; and in the grade below this, such men as Admiral Coligny, William III of England, Peter the Great, Prince Eugene of Savoy; Maurice, the Elector of Saxony; Charles XII of Sweden; the Great Turenne, and so on. Now if we accept the count of twenty real geniuses in this group of 823 members of royalty, we have one genius in forty appearing in this stock. How does this compare with the rest of the population?

A SELECTED BREED

In the whole period in question, covering a number of centuries, Woods thinks there have certainly not been more than 200 men of equal eminence produced by the entire population of the countries

concerned. Yet this population included some hundreds of millions of persons. Royalty, then, has several hundred thousand times as many chances of producing a genius, as has a family picked at random from the population at large. And this overwhelming chance is due, as I have attempted to show, not to the fact that royalty has an unusually good environment or more opportunities, but to the fact that the royal families are a selected breed, who owe their origin to some one's preeminence in statecraft, war and leadership, and who have been more or less consciously bred for these qualities ever since. It is a gigantic, if incomplete, experiment in eugenics. Of course, we might have preferred to see other qualities picked out as the basis for such an experiment; but whatever qualities we selected, whether in the scientific, artistic, or practical sphere, we have every reason to believe that we could have produced a breed of men where genius would be relatively as abundant as it is in this stock.

I have now shown you specimens of many kinds of the evidence on which we rely to prove our contention that man's qualities, physical, mental or moral, are far more due to heredity than to his environment. I will not multiply statistics: what I have set before you is a fair example of our ammunition. The conclusions to which this kind of inquiry leads are startling to most people, and we wish to use all due caution in stating them.

Let it be understood, then, that the problem of heredity vs. environment is an extremely complex one and cannot be solved in general terms. We can only attack each phase of it separately, disentangle factors that can be measured, and compare them with each other. I believe no one has ever questioned the propriety of this method of attack. In every case that has ever been tried, so far as I know, the influence of heredity has been shown to be overwhelmingly predominant, and the power of any ordinary change in environment to modify heredity has been shown to be insignificant. We therefore feel ourselves in a position safely to generalize to the extent of saying that the importance of nature is five or ten times greater than that of nurture in the making of a man.

Probably the objection will at once occur to some of you, that my entire line of reasoning is unfair, because I have been measuring the total force of heredity against some single factor of environment in each case. You may be willing to grant that the power of heredity is greater than that of any single factor of environment, but you may think that if I took all the factors of environment put together—provided such a thing were possible—and measured them against heredity, the sum of them would vastly outweigh heredity.

SUPERIORITY OF HEREDITY

This is not the case, but the proof demands too much mathematics to be given. I will do no more than tell you that it involves a principle known as multiple correlation, and the fact that the various factors of the environment are rather closely correlated to each other. The result of this is that even if we had an infinity of environmental factors, each separate one correlated to the individual to an equal degree with that individual's parents or grandparents, yet the effect of these parents and grandparents alone would be greater than that of this infinity of environmental factors of the same grade of correlation; to say nothing of the influence of more remote ancestors, who are by no means to be neglected. Such a statement may seem incredible to you; but if you are not mathematically inclined enough to investigate the subject for yourself, I will have to ask you to take the word of mathematicians for it, that such is incontrovertibly the fact. No one can successfully dispute, I think, that *heredity is not only much stronger that any single factor of the environment, in producing important human differences, but is stronger than any possible number of them put together.* It is on this fact that we base our claim for a consideration of heredity in the solution of social problems, which are now attacked mainly through the environment alone.

A rapidly growing and influential school of sociologists has already grasped

the situation, and is basing itself solidly on biology, on the facts that I have set before you this evening. But there are yet a great many social workers, particularly those who have been trained largely along psychological lines, who still show an extraordinary inability to reason accurately. An example of this school's attitude may be found in a recent article on "The Boy Who Goes Wrong" which H. Addington Bruce, a well-known writer on psychological topics, published not long ago in the Century Magazine. After alleging that the boy who goes wrong does so because he is not properly brought up, Mr. Bruce quotes with approval the following passage from "Dr. Paul Dubois, the eminent Swiss physician and philosopher:

"If you have the happiness to be a well-living man, take care not to attribute the credit of it to yourself. Remember the favorable conditions in which you have lived, surrounded by relatives who loved you and set you a good example; do not forget the close friends who have taken you by the hand and led you away from the quagmires of evil; keep a grateful remembrance for all the teachers who have influenced you, the kind and intelligent schoolmaster, the devoted pastor; realize all these multiple influences which have made of you what you are. Then you will remember that such and such a culprit has not in his sad life met with these favorable conditions; that he had a drunken father or a foolish mother, and that he has lived without affection exposed to all kinds of temptation. You will then take pity upon this disinherited man, whose mind has been nourished upon malformed mental images, begetting evil sentiments such as immoderate desire or social hatred."

ENVIRONMENT MISUNDERSTOOD

It is a thankless task to have to destroy such pretty sentimentality, but its prevalence is doing far more harm in the world, I dare say, than all the forces of charity and philanthropy can correct. Mr. Bruce indorses this kind of talk when he concludes, "The blame for the boy who goes wrong does not rest with the boy himself, or yet with his remote ancestors. It rests squarely with the parents who, through ignorance or neglect, have failed to mold him aright in the plastic days of childhood."

Where is the evidence of the existence of these plastic days of childhood? If they exist, why do not ordinary brothers become as much alike as twins, during them? How long are we to be asked to believe, on blind faith, that the child is putty, of which the educator can make either mediocrity or genius, depending on his skill? What does the environmentalist *know* about these "plastic days?" We long ago gave up expecting that Mr. Bruce and his friends would bring forward any proof that there was such a thing, but we still hope that they may learn to interpret their own facts in the light of knowledge, not dogma. If a boy has a drunken father or foolish mother, does it not occur to them that there is something wrong with his pedigree? If much of it is like that sample, we do not expect him to turn out well, no matter in what home he is brought up. If a boy has the kind of parents who bring him up well; if he is, as Dubois says, surrounded by relatives who love him and set him a good example, we at once have data for a suspicion that he comes of a pretty good family, a stock characterized by a high standard of intellectuality and morality, and it would surprise us if such a boy did not turn out well. But he turns out well because what's bred in the bone will show in him, if it gets any kind of a chance. It is his nature, not his nurture, that is mainly responsible for his character.

Such is our conclusion, based on a great many facts of the kind I have presented to you here this evening. We have never found a fact that has contradicted this conclusion. If anyone has ever found such a fact, I do not know of it. He will make himself famous if he will give it publicity.

We do not for a minute desire to depreciate the importance, the necessity of a good environment. If it is not good, and equally good for every man, then some men's good hereditary traits will fail to get expression, we will not

know what they are really worth, and eugenics will lose valuable material that it needs. We want the best environment that science can create, but we shall not ask it to make good heredity out of bad, because it can not do so. Our desire is rather to give it as large a supply as possible of good heredity with which to work. Karl Pearson has effectively stated the eugenist's attitude in his allegory of a certain workman who found his chisel ineffectual. "He hardened it and he tempered it, and he gave it a cutting edge on the grindstone, and he finished up on the oilstone. Then he tried his chisel again and in ten minutes it was as ineffectual as before. Then he repeated the whole process and again the chisel failed him. Then he proceeded to 'turn up' his grindstone and replaced his oilstone by an American product, but all in vain; the chisel still refused to do efficient work. Just as he was proceeding to the process of 'hacking' his grindstone and to trying a brand-new German hone, a fellow workman suggested that the *steel of his chisel might possibly be at fault*. Instead, however, of proceeding to test the amount of carbon in his steel, or to try his workshop appliances on another chisel, our first workman grew angry and asserted that his colleague was neglecting all the resources of modern technology, all the advances of applied science. If hardening and tempering, if grindstone and oilstone were idle, we might as well throw aside all mechanical progress and again make our tools by chipping flints."

What, after all, should be our policy of social improvement? Is heredity everything and environment a superfluity? Is improvement of social conditions a waste of time? "Are we then to discard the methods of civilization, to describe as worthless the whole field of liberal and social reform," because we find that the force of heredity is so much greater than the force of environment? "Are we to throw aside the oilstone and break up the grindstone because they cannot make bad steel into an effective tool? Surely they are necessities for the proper working of a good tool. The mistake in our social policy has been that we supposed them primary and not secondary, that we thought to advance the nation by legislation which has hampered nature, to provide nurture for the feeble, for the inherently weak stock, the steel of which grindstone and oilstone will and can make nothing."

We will not sacrifice any of the good parts of our present social fabric; but we must have a nation with a higher level of heredity, to make the best possible use of this social fabric.

NEW PUBLICATIONS

HEREDITY AND ENVIRONMENT IN THE DEVELOPMENT OF MEN, by Edwin Grant Conklin, Professor of Biology in Princeton University. Pp. xiv+533, price $2 net. Princeton, New Jersey, The Princeton University Press, 1915.

Chosen to deliver the N. W. Harris lectures at Northwestern University last year, Professor Conklin discussed at length the subject of human genetics, from the standpoint of a cytologist, and has now published these lectures in the form of a book, which discusses the practical application of a knowledge of development to the human race. The first 187 pages explain the biological foundation of eugenics, in the cell and its development; the next 206 pages review our present knowledge of the phenomena of inheritance; the influence of the environment is then discussed and its great importance emphasized by an appeal to the facts of development, which many genetists are prone to overlook; the eugenics movement and its ethical basis occupy the remainder of the book, save for a useful bibliography and glossary. It can be recommended without qualification to anyone who wishes to gain a sound knowledge of the biological basis of eugenics—and that ought to include every one seriously interested in the subject.